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Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USS-A, Washington, D.C., 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y., 10017.

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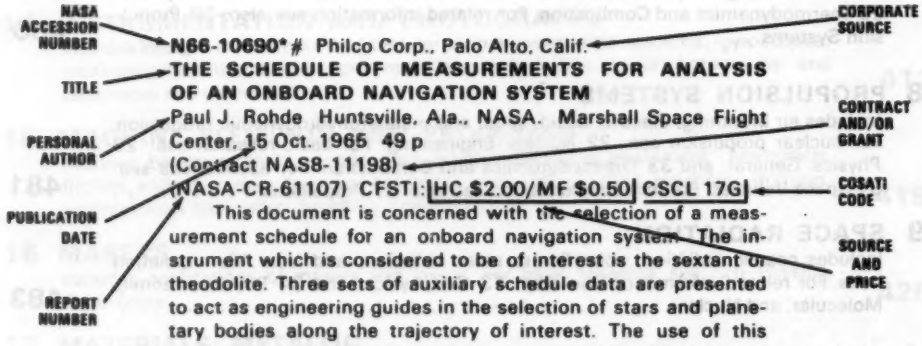

N66-10690*# Philco Corp., Palo Alto, Calif.
THE SCHEDULE OF MEASUREMENTS FOR ANALYSIS OF AN ONBOARD NAVIGATION SYSTEM
Paul J. Rohde Huntsville, Ala., NASA. Marshall Space Flight Center, 15 Oct. 1965 49 p
(Contract NAS8-11198)
(NASA-CR-61107) CFSTI: HC $2.00/MF $0.50 CSCL 17G

This document is concerned with the selection of a measurement schedule for an onboard navigation system. The instrument which is considered to be of interest is the sextant or theodolite. Three sets of auxiliary schedule data are presented to act as engineering guides in the selection of stars and planetary bodies along the trajectory of interest. The use of this auxiliary data is demonstrated along a round trip Mars trajectory and a lunar trajectory. The value of using the auxiliary data as a guide is verified by obtaining tracking schedule evaluation data from a digital computer simulation of an onboard tracking system.
Author

TYPICAL CITATION AND ABSTRACT FROM *STAR*

VOLUME 4 NUMBER 3

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01

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-12153*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF WING PLANFORM ON THE AERODYNAMIC CHARACTERISTICS OF A WING-BODY-TAIL MODEL AT MACH NUMBERS FROM 1.70 TO 4.63

Lloyd S. Jernell Washington, NASA, Dec. 1965 63 p refs (NASA-TN-D-3105) CFSTI: HC $3.00/MF $0.75 CSCL 01A

An investigation has been conducted in a wind tunnel to determine the effects on the aerodynamic characteristics in pitch and sideslip of a series of wing planform modifications to a wing-body-tail model. The tests were conducted at angles of attack from about −3° to 25° for angles of sideslip of about 0° and 5°, at Mach numbers from 1.70 to 4.63, and a Reynolds number per foot (per 0.3048 m) of 3.0×10^6. The addition of trailing-edge inserts to the basic wing progressively reduced the pitch-up characteristics occurring at the lower Mach numbers. Increasing the wing area lessened the adverse effects on directional stability which occurred with increasing lift coefficient. The wing planform did not affect the effective dihedral except to improve the linearity with respect to lift as the aspect ratio was decreased. In all cases the addition of wing area was accompanied by an increase in the maximum lift-drag ratio.

Author

N66-12292# Aeronautical Research Council (Gt. Brit.)

BOUNDARY-LAYER DRAG OF BI-CONVEX WING SECTIONS WITH HEAT TRANSFER AT SUPERSONIC SPEEDS

R. E. Luxton and A. D. Young (Queen Mary Coll., London) London, HMSO, Mar. 1964 44 p refs Supersedes ARC-25685; see X64-15137

(ARC-R&M-3393; ARC-25685)

Previously published methods for the calculation of the skin friction and growth of compressible laminar and turbulent boundary layers in the presence of heat transfer are applied to bi-convex wings of 5% thickness at Mach numbers of 1.5, 2.5 and 5.0, and Reynolds numbers of 10^6, 10^7 and 10^8 for a range of transition points and a range of heat-transfer conditions. Similar calculations are also made for a flat plate at zero incidence for the same ranges of Reynolds number and Mach number. It is shown that the effect of rearward movement of transition is reduced by increase in Mach number, by reduction in Reynolds number and by increase in the wall to recovery temperature ratio. These results are explained in terms of the relative sensitivities of the laminar and turbulent boundary layers to these parameters. Some discussion is offered of the effects on skin friction of the interaction between the boundary layers to these parameters. Some discussion is offered of the effects on skin friction of the interaction between the boundary layer and the external flow and also the effects of small changes in the Prandtl number and viscosity-temperature index are considered. It is shown that in general cooling of the surface causes an increase in drag for all transition points except those very close to the trailing edge. It is concluded that if wing surfaces are cooled to avoid the otherwise serious effects of aerodynamic heating at high speeds then with increase in Mach number it becomes increasingly desirable for the boundary layer to be kept laminar to very near the trailing edge.

Author

N66-12316# Aeronautical Research Council (Gt. Brit.)

THEORETICAL INVESTIGATION OF SOME BASIC ASSUMPTIONS OF SCHLICHTING'S SINGULARITY METHOD OF CASCADE ANALYSIS

R. I. Lewis and G. A. Pennington London, HMSO, 1965 37 p refs

(ARC-CP-813) HMSO: 7s

The accuracy of Schlichting's kinematic source flow equation has been investigated for an isolated symmetrical aerofoil. Studies are presented also of the suitability of the Glauert series for representing profiles by source/vortex distributions. Influence of data rounding off error upon profile analysis with large numbers of control points has been examined, and importance of data accuracy and smoothness stressed. An estimation of the optimum number of control points has been made for a typical profile. A method of initial data processing to ensure a valid computation has been suggested.

Author

N66-12317# Aeronautical Research Council (Gt. Brit.)

TESTS WITH A VARIABLE RAMP INTAKE HAVING COMBINED EXTERNAL/INTERNAL COMPRESSION, AND A DESIGN MACH NUMBER OF 2.2

M. C. Neale and P. S. Lamb London, HMSO, 1965 27 p (ARC-CP-805) HMSO: 6s 6d

Results are reported of tests on a two-dimensional combined external/internal compression intake having a design Mach number of 2.2 The effects of changes in the form of the ramp bleed slot and the subsonic diffuser were examined. In addition tests were made with a crude form of a sidewall bleed. The maximum pressure recovery obtained at the design Mach number was 87 percent with a bleed of 2.8 percent of the capture flow.

Author

N66-12473# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

NOTES ON JET IMPINGEMENT AND ON THE LIMITING LIFT FOR A FINITE ASPECT RATIO WING

E. W. Graham Aug. 1964 20 p refs
(TM-34)

Discussions are presented on jet impingement problems concerning measurements, hysteresis effects, and rotationally symmetric obstacles; the progressive loss of lift on a finite aspect ratio wing and maximum lift from slender wing theory; and the compressibility effects on an infinite swept wing. R.N.A.

N66-12749# Northrop Corp., Hawthorne, Calif. Norair Div.
INVESTIGATION OF A 10 FT. CHORD 33° SWEPT LOW DRAG SUCTION WING AT HIGH REYNOLDS NUMBERS
Summary Report
W. Pfenninger [1965] 48 p refs Presented to the AF Div. Advisory Group, 14 Oct. 1965

Low drag suction experiments were conducted in pressure tunnels on a 33° swept 10 ft chord low drag suction wing model. These experiments verified extensive laminar flow up to wing chord Reynolds numbers $R_c = 48 \times 10^6$ At $R_c = 44.8 \times 10^6$ 90% laminar flow was maintained, corresponding to a transition length Reynolds number of 40.3×10^6. The minimum equivalent wing profile drag coefficient for the test surface was 0.00088 at $R_c = 29.4 \times 10^6$ (including the equivalent suction drag); it increased to $\cong 0.0011$ at $R_c \cong 43 \times 10^6$. Observed disturbances are discussed, and possible correction steps are included. Besides the ordinary measurements on low drag suction surfaces, the following observations and measurements were conducted: flow observations at the downstream end of the front wing attachment line, measurement of the sound pressures along the suction ducts in the presence of internal noise, transition observations in the presence of noise, chordwise u′ boundary layer velocity fluctuation measurements, and external tunnel noise measurements. C.T.C.

N66-12776# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EFFECT OF FLAP BLOWING ON THE SECTIONAL CHARACTERISTICS OF AN NACA 0015 AIRFOIL
Rayford P. Patrick (M.S. Thesis) Mar. 1965 39 p refs
(GAM-65A/AE/65-2; AD-621431)

Variation of the maximum lift coefficient, the pressure drag coefficient, leading edge and hinge moment coefficients, angle of attack at stall, and slope of lift curves with different momentum coefficients are investigated. The friction drag is investigated and compared to the pressure drag. Also the moment coefficient required to obtain theoretical flap effectiveness at several flap deflections, an optimum flap deflection for largest increase in lift, and an optimum flap deflection for largest percentage increase in lift are investigated. TAB

N66-12796# Aerospace Corp., San Bernardino, Calif.
A THEORY OF THE AERODYNAMICS OF THE SUPERSONIC SPLITLINE GIMBALED NOZZLE
Warren C. Strahle Aug. 1965 52 p refs
(Contract AF 04(695)-469)
(TDR-469(S5951-18)-1; BSD-TR-65-389; AD-469896)

A theory is developed of the internal aerodynamics of the supersonic splitline gimbaled nozzle. A parametric survey is conducted to better understand the aerodynamic behavior of this thrust vector control device. The theory is based on a three-dimensional, small-perturbation treatment upon an originally undisturbed supersonic source flow. Topics of primary interest are nozzle scaling, pivot point location for minimum actuation power, splitline geometry effects, thrust vector deflection amplification and suppression, and the practical implications of designing for low actuation torques. Comparison with experiment is given. Author (TAB)

N66-12811# Rice Univ., Houston, Tex.
THREE-DIMENSIONAL WINGS OF MINIMUM TOTAL DRAG IN NEWTONIAN FLOW
David G. Hull and Angelo Miele 1965 41 p refs
(Grant AF-AFOSR-828-65)
(AAR-3; AD-468760)

In previous papers, the airfoil shape of a slender, two-dimensional, symmetric wing at zero angle of attack in hypersonic flow was determined so as to minimize either the pressure drag or the total drag, that is, the sum of the pressure drag and the friction drag. In this paper, the more general problem of minimizing the total drag of a three-dimensional wing is considered. The analytical difficulty of the minimal problem is increased to a considerable degree insofar as a surface integral, rather than a line integral, is to be extremized. In spite of this, the minimal problem is amenable to an analytical approach provided convenient engineering hypotheses are employed concerning the geometry of the wing and the distributions of pressure coefficients and skin-friction coefficients. In the following sections, the necessary conditions to be satisfied by extremal surfaces are discussed, and minimum drag wings are determined for various conditions imposed on the planform shape, the planform area, the distribution of thicknesses on the trailing edge, and the volume. Author (TAB)

N66-12894# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
UNSTEADY SUPERSONIC FLOW OVER A CONE WITH A BLUNTED TIP [NESTATSIONARNOE SVERKHZVUKOVOE OBTEKANIE KONUSA S OKRUGLENNOI VERSHINOI]
G. F. Telenin and G. P. Tinyakov Dec. 1962 26 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 2, 1961
(TR-24)

Equations and calculations are presented which describe the unsteady supersonic flow over a cone with a blunted tip. R.N.A.

N66-12906# Reilly Translations, Los Angeles, Calif.
FLAPWING CRAFT
N. S. Posysayev [1965] 3 p ref Transl. into ENGLISH from Priroda (Moscow), no. 2, Feb. 1965

A discussion is presented on the possibility of flight by flapping wings. The flight efficiencies of several birds are discussed. The advantages of flying craft with flapping wings are pointed out and include safety in flight and landing, the ability to attain flight even when forward speed is lacking, and the ability to make a smooth landing in the event of engine failure simply by flapping. Several factors affecting the function of wings have been learned including torsional oscillation, slit wing, wing equilibrium in motion, and the effect of feather structures. R.N.A.

N66-12950# Aeronautical Research Council (Gt. Brit.)
A THEORY OF THE BLOCKAGE EFFECTS ON BLUFF BODIES AND STALLED WINGS IN A CLOSED WIND TUNNEL
E. C. Maskell London, HMSO, 1965 25 p refs Supersedes RAE-AERO-2685; ARC-25730
(ARC-R&M-3400; RAE-AERO-2685; ARC-25730) HMSO: 9s 6d

A theory of blockage constraint on the flow past a bluff body in a closed wind tunnel is developed, using an approximate relation describing the momentum balance in the flow outside the wake, and two empirical auxiliary relations. The theory is well supported by experiment and leads to the correction formula $\Delta q/q = \epsilon C_D S/C$ where Δq is the effective increase in dynamic pressure due to constraint, and ϵ is

a blockage factor dependent on the magnitude of the base-pressure coefficient. The factor ϵ is shown to range between a value a little greater than 5/2 for axisymmetric flow to a little less than unity for two-dimensional flow. But the variation from 5/2 is found to be small for aspect ratios in the range of 1 to 10. The theory is extended to stalled wings, and an appropriate technique for the correction of wind-tunnel data is evolved. Author

N66-12984*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESULTS OF THE JPL AERODYNAMIC DAMPING-IN-PITCH WIND-TUNNEL PROGRAM
Duane A. Nelson 2 Nov. 1962 49 p refs
(Contract NAS7-100)
(NASA-CR-68186; WT-20-499) CFSTI: HC $2.00/MF $0.50 CSCL 01

Model configurations consisting of a sphere, a truncated cone with spherical ends, a truncated cone with spherical front and conical rear end, and a truncated cone with spherical front and flat rear end underwent dynamic stability tests in supersonic and hypersonic wind tunnels. Aerodynamic damping pitch data were obtained for Mach numbers 1.81, 2.01, 3.01, 3.26, 3.99, 4.54, 5.0, 6.0, and 8.3, and Reynolds numbers from 0.01×10^6 to 0.30×10^6/in. Models were mounted on a gas bearing and measurements were made by recording the angle-of-attack versus time history of the models, which were allowed to oscillate until damped by the air flow and the bearing friction. Results of the tests were reduced to coefficients and are presented in plots. G.G.

N66-13017*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT INVESTIGATION OF THE AERODYNAMIC PROPERTIES OF AN OGEE WING
L. Steward Rolls, David G. Koenig, and Fred J. Drinkwater III Washington, NASA, Dec. 1965 22 p refs
(NASA-TN-D-3071) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The low-speed characteristics of a delta-wing aircraft modified to an Ogee plan form were investigated in flight and in the Ames 40- by 80-Foot Wind Tunnel. The flight results showed the aircraft had good flying qualities with improved lateral-directional control characteristics. The flight characteristics of the aircraft were sufficiently improved that the pilot was willing to lower the approach speed 10 knots.
Author

N66-13175# Aeronautical Research Council (Gt. Brit.)
LIFT DUE TO INTERFERENCE BETWEEN AN AEROFOIL AND AN EXTERNAL NON-LIFTING BODY
S. Neumark London, HMSO, 1965 22 p refs Supersedes RAE-TN-AERO-2960; ARC-26188
(ARC-R&M-3411; RAE-TN-AERO-2960; ARC-26188) HMSO: 9s 6d

This paper contains an attempt to explain the incremental negative or positive lift induced on an aerofoil by an external non-lifting body (such as an engine nacelle), as observed in some experiments. A two-dimensional theory is proposed, based on representing the body by a system of sources and sinks, and by determining their effect on the aerofoil by means of a suitable conformal transformation. Two simple cases are considered: a semi-infinite body corresponding to a single source, and a finite body of oval shape corresponding to one source and one sink. Formulae for the induced-lift coefficient and for the position of center of pressure are derived and illustrated by diagrams. Only incompressible flow is considered. Author

N66-13199# Institut Franco-Allemand de Recherches, St. Louis (France).
[HYPERSONIC SIMILITUDE] [SIMILITUDE HYPERSONIQUE]
A. Auriol and J. Balazard 1963 50 p refs In FRENCH
(ISL-1/63) CFSTI: HC $3.00/MF $0.50

The flow of a real nonviscous gas in chemical equilibrium, about any obstacle, can possibly be characterized by a single matrix of the function h(u), each function h corresponding to an entropy given by

$$h = \frac{H - H_e}{\frac{p}{\rho}} \quad \text{and} \quad u = \frac{V}{V_e}$$

where H=enthalpy, p=pressure, ρ=density, and V=velocity. V_o is the velocity prior to the encounter with the obstacle; and V is the velocity of any point whatsoever of the flow. In order that two hypersonic flows be alike, it is necessary and sufficient that the matrices of h(u) of two flows coincide. The equivalance of the quantities h to the apex of the waves resulting from the encounter are sufficient to assure the similitude in the subsonic flow region upstream from a blunt body. This condition is tantamount to the equality of the quantities

$$\epsilon = \frac{\rho_1}{\rho_0}$$

at the apex of the encounter, where ρ_0 and ρ_1 are the densities before and after the encounter. Transl. by D.T.

N66-13204# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CALCULATION OF MOMENT COEFFICIENTS OF SELF-DAMPING AND EFFECTIVENESS OF AIR STEERING RUDDERS OF "FLYING PLATFORM" ON HOVERING REGIME
Ye. A. Kuklev 21 May 1964 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1962 p 12–17
(FTD-MT-63-287; AD-619545)

Control of ducted-fan helicopter of the 'flying platform' type is carried out in most cases by air vanes with the help of which during calculation of self-damping of the platform there is ensured both a proper margin of stability and also a definite speed of attenuation of perturbed motions. First order of approximations give simple calculating formulas for appraisal of effectiveness of air vanes and self-damping of 'flying platform' on conditions of hovering. Author

N66-13233*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN APPROXIMATE METHOD FOR SOLVING THE SINGLE-DEGREE-OF-FREEDOM ROLL EQUATION WITH TIME-DEPENDENT COEFFICIENTS
C. William Mertz Washington, NASA, Dec. 1965 23 p refs
(NASA-TN-D-3158) CFSTI: HC $1.00/MF $0.50 CSCL 01A

An approximate analytical method (with three alternate integration procedures) is developed for solving the single-degree-of-freedom roll equation with time-dependent coefficients. The method is applied with each integration procedure to two sample problems and shows good agreement with more exact numerical solutions. Information governing the approximate error of each integration procedure is also presented. Author

N66-13236*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DRAG CHARACTERISTICS OF A SERIES OF LOW-DRAG BODIES OF REVOLUTION AT MACH NUMBERS FROM 0.6 TO 4.0

Roy V. Harris, Jr. and Emma Jean Landrum Washington, NASA, Dec. 1965 32 p refs
(NASA-TN-D-3163) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An analytical and experimental study has been made of the drag characteristics of a series of low-drag bodies of revolution at Mach numbers from 0.6 to 4.0. The bodies considered in this study are length-volume Haack–Adams bodies and were derived, with the use of slender-body theory, to have a minimum wave drag for a given length, volume, and base area. Although the wave drag of these bodies can be considered as minimum only for that particular class of bodies which are either closed (zero base radius) or have zero surface slope at the base, it has been shown that the wave drag of these bodies is only slightly greater than that for the minimum-wave-drag body. When the body base area is zero, the Haack–Adams bodies are identical with the Sears–Haack bodies. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-12151*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-SPEED FORCE AND FLIGHT INVESTIGATION OF VARIOUS METHODS FOR CONTROLLING PARAWINGS
Joseph L. Johnson, Jr. Washington, NASA, Dec. 1965 51 p refs Technical Film Supplement L-882 is available on loan from Langley Res. Center
(NASA-TN-D-2998) CFSTI: HC $2.00/MF $0.50 CSCL 01C

A preliminary low-speed, wing-tunnel investigation has been made to study various methods of controlling parawings. Force tests were first made with a simple model to study various methods of control. Some of the control systems which appeared promising on the basis of the force-test results were evaluated under dynamic conditions in a flight-test investigation of a model of a parawing utility vehicle. The study was initiated because the center-of-gravity shift used as a control system on some parawing configurations has resulted in relatively large stick forces and unstable stick-force gradients, inertia feedback problems, and poor lateral control effectiveness under some conditions of flight. The results of the investigation indicated that such devices as horizontal control surfaces, trailing-edge boltropes, trailing-edge risers, and hinged wing tips offered enough promise for providing a satisfactory means of controlling parawings to warrant further consideration. The particular control device best suited for a given parawing configuration, however, will probably depend to a large extent on both the type of application and the particular handling-qualities requirements set forth for that application. Author

N66-12365# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF COMPENSATING THE AIRPLANE'S TURNING MOMENT IN LANDING WITH A BRAKE PARACHUTE IN A STRONG SIDE WIND
Ya. A. Livshits and M. S. Aretskin 20 Sep. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 163079 (Appl. No. 761697/40-23, 23 Jan. 1962) 1 p
(FTD-TT-65-506/1+4; AD-621777)

The object of the invention is a method for compensating the turning moment of an airplane on landing with a brake parachute under conditions of a strong side wind which has the distinguishing feature that for the purpose of assuring a safe run of the airplane one releases after the basic brake parachute one of two supplementary stabilizing parachutes, as depends on the direction of the side wind, located on the wings symmetrically at the greatest distance from the center of gravity of the airplane. Author (TAB)

N66-12386# Hughes Tool Co., Culver City, Calif. Aircraft Div.
AIRCRAFT DESIGN, XV-9A HOT CYCLE RESEARCH AIRCRAFT Final Report, 28 Sep. 1962–15 Mar. 1965
Norman B. Hirsh Ft. Eustis, Va., Army Aviation Mater. Lab., Aug. 1965 322 p refs
(Contract DA-44-177-AMC-877(T))
(HTC-AD-64-11 (385-X-05); USAAVLABS-TR-65-29; AD-621684)

A summary of the design of the XV-9A Hot Cycle Research Aircraft is presented. A discussion of the concepts utilized in design and additional information relating to configuration, weight and balance, performance, stability and control, dynamics, and structural characteristics are presented. Author (TAB)

N66-12485# Ling-Temco-Vought, Inc., Dallas, Tex. Aeronautics Div.
APPLICATION OF A METHOD FOR ESTABLISHING LANDING DESIGN CRITERIA FOR CARRIER-BASED AIRPLANES Final Report
W. W. Hoy, W. W. Kitts, and N. H. Sandlin 1 Aug. 1965 118 p refs
(Contract NOw-64-0359-f)
(Rept.-2-53470/5R2203; AD-470913)

Examples illustrating the applicability of a method for establishing landing loads criteria for carrier-based airplanes are presented in this report. Four mathematical models of hypothetical airplane landing gears, each of increasing complexity, are defined, and the solutions of the associated equations of motion are used to illustrate the previously developed methods for determining design loads and fatigue spectrums. Author (TAB)

N66-12790# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TOMORROW OF AVIATION Selected Articles
Ye. Pavlov et al 15 Sep. 1965 19 p Transl. into ENGLISH from Nauka i Tekhn. (Riga), no. 1, 1965 p 37–40
(FTD-TT-65-745/1+2; AD-621796)

The future of aviation, hypersonic aircraft, power plants, hypersonic aircraft engines, rocket systems to inject space vehicles into orbit, and ion reaction engines are reviewed. It is pointed out that chemistry can have a tremendous effect on the development of aviation, particularly in obtaining high strength and extremely light materials for aircraft construction. Further, it is indicated that mechanical control facilities will gradually disappear, to be replaced by controls using biocurrents. In the latter respect, people of the future will need bioelectrical physical training in conjunction with various forms of exercises and calisthenics based on biocurrents. R.R.D.

N66-12919# Federal Aviation Agency, Washington, D. C. Aircraft Development Service.
AN EVALUATION OF THE HEIGHT VELOCITY DIAGRAM OF A LIGHTWEIGHT, LOW ROTOR INERTIA, SINGLE ENGINE HELICOPTER
William J. Hanley and Gilbert De Vore Jul. 1965 59 p refs
(FAA-ADS-46)

A series of flight tests was conducted at three selected altitudes (sea level, 5000 feet, 7000 feet) to determine the effects of altitude and weight on the height-velocity (H-V) diagram of a small, lightweight, low rotor inertia, medium disk loading, single rotor, single engine helicopter. Results disclosed a family of curves showing that increases in density altitude and/or gross weight enlarged the H-V diagram required for a safe power-off landing. Analysis of the results revealed that the key points (V_{cr}, h_{min}, and h_{max}), which partially define the curves, could be determined by the solution of a set of linear equations. These results were identical to those reported in FAA Technical Report ADS-1 except for the constants of the linear equations and the location of the critical height (h_{cr}). The critical height indicated a slight increase as weight, altitude and collective pitch reduction time delay were increased. An average value for h_{cr} can be selected without upsetting the family of curves. Author

N66-12927# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.

EVALUATION OF RUNWAY IMPRESSION FENCES Final Report

Donald J. Bourque Jun. 1965 22 p refs
(RD-65-85)

The runway impression fence was developed as a safety device to minimize landings in the undershoot area. The Federal Aviation Agency conducted operational evaluations at Houston International Airport, Houston, Texas, and at Bradley Field, Windsor-Locks, Connecticut, to determine the effectiveness and suitability of the runway impression fence for reducing the likelihood of undershoots at civil airports. Aircraft crossing heights at threshold were measured before and after the installation of runway impression fences. Statistical comparisons of these data were made to determine the effectiveness of the fence. Data were also collected on damage to various fence post designs. It was concluded that runway impression fences are effective in reducing the likelihood of undershoots at civil airports during daylight and not significantly effective at night. It was recommended that runway impression fences be considered as a means of reducing the number of undershoots at runways where short landings would be unsafe and that the final fabrication and installation procedures used at Bradley Field be employed until a superior design is developed through further study and field testing. Author

N66-13053# Fiat S.P.A., Turin (Italy).

MINIMUM IDEAL AND ACTUAL SPECIFIC FUEL CONSUMPTION OF VTOL AIRCRAFT AND HELICOPTERS IN HOVERING

Giuseppe Gabrielli Nov. 1965 16 p refs CFSTI: HC $1.00/MF $0.50

The minimum ideal fuel consumption based on fuel chemical energy with a calorific power of 10000 cal/kg, and the actual values of the specific fuel consumption referred to the total weight of various VTOL aircraft and helicopters are shown versus the specific loading of the operator system. It is shown that for the VTOL aircraft values of the actual specific fuel consumption increase from 0.140 to 1.200 kg/kgh corresponding to a specific loading from 180 to 11000 kg/m^2, while the conventional efficiency factor of the power-operator system varies from 0.275 to 0.565. The conventional fuel consumption for some helicopters with mechanical transmission and pneumatic transmission is also presented. The actual fuel consumption is greatly affected by the power transmission system and the efficiency factors of various types differ considerably. The selection of any system depends also on the weight of the power and operator systems. E.E.B.

N66-13235*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

RESPONSE OF A TURBOJET AND A PISTON-ENGINE TRANSPORT AIRPLANE TO RUNWAY ROUGHNESS

Garland J. Morris Washington, NASA, Dec. 1965 34 p refs
(NASA-TN-D-3161) CFSTI: HC $2.00/MF $0.50 CSCL 01B

An investigation was conducted to determine the response characteristics of a turbojet transport airplane and a piston-engine transport airplane on runways having different roughness characteristics. Airplane normal-acceleration response increased with increasing taxi speed and was of about the same magnitude at the center of gravity of both airplanes at similar taxi speeds on the same runways. Root-mean-square normal accelerations in the pilot compartment of the turbojet airplane exceeded those at the center of gravity by from 45 to 110 percent. Pitching velocity and normal acceleration measured near the center of gravity and in the pilot compartment of the turbojet airplane during taxiing on the three runways varied in magnitude in the same order as did the relative levels of roughness indicated by power spectra of the runway profiles. For the turbojet airplane, the ratio of the airplane normal-acceleration spectra to the runway spectra did not define a unique transfer function which was independent of input amplitude and airplane speed. Author

N66-13239*# National Aeronautics and Space Administration, Washington, D. C.

THEORETICAL STUDY OF THE PROPAGATION OF SOUND. APPLICATION TO ANTICIPATION OF THE SONIC BOOM PRODUCED BY SUPERSONIC FLIGHT [ETUDE THEORETIQUE DE LA PROPAGATION DU SON. APPLICATIONS A LA PREVISION DU BRUIT BALISTIQUE PROVOQUE PAR LE VOL SUPERSONIQUE]

Jean-Pierre Guiraud Dec. 1965 339 p refs Transl. into ENGLISH of the Office d'Etudes et de Rech. Aerospatiales, Rept. TP, no. 104, 1964
(NASA-TT-F-387) CFSTI: HC $7.00/MF $1.75 CSCL 01A

Mathematical theories of acoustics are applied to the propagation of plane, circular, and multidimensional sound waves in homogeneous and inhomogeneous media in motion and at rest. The Mach wave train of a supersonic aircraft in calm and moving air is calculated in detail, taking shock wave propagation and sonic boom prediction into consideration. The structure of nonlinear wave trains is mathematically defined at $O(c_0\epsilon^2)$ perturbation velocity and $O(c_v\epsilon^3)$ entropy perturbation where c_0 is the speed of sound, c_v the velocity of sound in vacuum, and ϵ the order of magnitude of the perturbations. The acoustic effect of the fuselage and of various wing planforms on the ambient air, as a function of the laws of thicknesss and stress, is calculated. The sonic boom is calculated, with allowance for the dissipation phenomena, and modified equations of motion in canonical Burgers form, are given, using $x = 0$ as the Mach wave associated with supersonic flight. Author

N66-13241*# Massachusetts Inst. of Tech., Cambridge.

BEHAVIOR OF THE SONIC BOOM SHOCK WAVE NEAR THE SONIC CUTOFF ALTITUDE

Manfred P. Friedman and David C. Chou Washington, NASA, Dec. 1965 49 p refs
(Contract NAS1-2511)
(NASA-CR-358) CFSTI: HC $3.00/MF $0.50 CSCL 01A

A detailed description is presented of the behavior of a sonic boom shock wave near the sonic cutoff altitude. The analysis is based on a model atmosphere in which sound decreases linearly with altitude. It is shown that existing theories using geometrical acoustic ray tube concepts do not correctly describe the situtation near cutoff. As the shock first

propagates away from the aircraft its strength decreases. However, as it approaches a region where the flow behind the shock is transonic the pressure jump across the shock increases, despite the fact that the Mach number is decreasing. The pressure jump increase is caused by accumulated disturbances behind the shock which are unable to propagate away in this transonic flow region. When the flow behind the shock is fully subsonic the pressure jump again decreases, the shock finally ending, at zero strength, embedded in a compression wave. Author

N66-13243# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).
LAY-OUT AND APPLICATION OF EJECTORS FOR V/STOL-AIRPLANES, THIRD PART [DIE ANWENDUNG DES EJEKTORS BEI V/STOL-FLUGZEUGEN UND DESSEN AUSLEGUNG, 3. TEILBERICHT]
Chr. Storkebaum Apr. 1965 55 p refs In GERMAN; ENGLISH and FRENCH summaries
(DLR-FB-65-25) CFSTI: HC $3.00/MF $0.50

Experimental results on static low pressures occurring with ejectors and the attainable thrust augmentation are presented. A model system of ejectors of different length, diameter, inlet, and exhaust pattern was measured in a model test rig. The test results are compared with the theoretical results, thus data on the occurring losses are obtained. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-12157*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TORQUE REQUIREMENTS FOR ORIENTATION OF A SOLAR BRAYTON SYSTEM IN EARTH ORBIT
Donald L. Sowers Washington, NASA, Dec. 1965 31 p refs
(NASA-TN-D-3142) CFSTI: HC $2.00/MF $0.50 CSCL 10B

Several torques that must be considered in the orientation control of a solar Brayton power system are analyzed. The torques are divided into three groups: external, internal reaction, and torque necessary to compensate for variations in angular velocity. For each group of torques, general equations are derived and numerical values of the torques are calculated for a typical 10-kilowatt solar Brayton system in a 300-nautical-mile ecliptic orbit. Of the external torques, gravitational and aerodynamic on the collector are the largest. They are sinusoidal and have maximums of 2.5×10^{-3} and 1.65×10^{-3} foot-pound, respectively. Torque due to solar radiation on the collector is several orders of magnitude smaller. The internal reaction torque, which is caused by accelerations of the turbomachinery, is the largest torque considered. A torque as large as 0.82 foot-pound is due to acceleration of the turboalternator during a typical alternator load transient. Torque necessary to compensate for variations in angular velocity is shown to be negligible. This torque compensates for angular acceleration with respect to the Sun by applying an equal angular acceleration to the power system about its center of gravity. Author

N66-12168*# Union Carbide Corp., Parma, Ohio. Research Lab.
STUDY PROGRAM TO IMPROVE FUEL CELL PERFORMANCE BY PULSING TECHNIQUES Final Report, Quarter Ending Aug. 31, 1965
M. L. Kronenberg [1966] 73 p refs
(Contract NAS3-6460)
(NASA-CR-54767) CFSTI: HC $3.00/MF $0.75 CSCL 10A

It has been observed that under certain conditions, heavy discharge pulses show varying degrees of improvement on the performance level of different types of fuel cell electrodes. In this investigation these conditions were defined on six different types of electrodes: Union Carbide plastic bonded and baked carbon electrodes; American Cyanamid electrodes; Justi-type electrodes; platinum sheet electrodes; and porous nickel electrodes. Studies were also conducted to determine the effect of pulsing on performance level and electrode life. The results obtained indicated that pulsing is primarily a catalyst reactivation treatment and is most effective in improving the performance level of electrodes that are catalyst limited from the start, or become catalyst limited during the life of the electrode. Electrodes that contained less than 2 mg/cm^2 of catalyst normally showed improvements of about 10 mv per pulse when operated in the current density range of 20-100 ma/cm^2. Electrodes containing high catalyst concentrations (9-40 $mg\text{-}cm^2$) normally showed improvements of about 2 mv per pulse when operated in the current density range of 20-250 ma/cm^2. Studies on nonporous platinum metal electrodes show that these electrodes show rapid losses in catalytic activity with time in H_2-saturated alkaline solutions. Author

N66-12169*# Monsanto Research Corp., Everett, Mass. Boston Lab.
RESEARCH AND DEVELOPMENT OF THE DRY TAPE BATTERY CONCEPT Quarterly Report No. 1, 9 Jun.–8 Sep. 1965
J. J. Byrne, L. F. Athearn, J. C. Mac Donald, and D. L. Williams
8 Oct. 1965 51 p refs
(Contract NAS3-7624)
(NASA-CR-54782; MAB501Q1) CFSTI: HC $3.00/MF $0.50 CSCL 10C

A dry tape battery couple, based on the $Mg/AlCl_3.HCl/$ trichlorotriazinetrione system was developed. The cell discharges at 2.6 volts at $0.2A/in.^2$ and 2.2 volts at $0.8\ A/in.^2$ Cathode coulombic efficiencies range from 60% to 80%, with individual test results as high as 87%. The discharge curve is flat and current density has little effect on the cathode efficiency. The tape couple can tolerate current drains in excess of $1A/in.^2$, but cell voltage falls below 2.0 volts. Work towards the development of the anode is also reported. Electrochemical test apparatus and preparations were made to study the system of lithium in nonaqueous electrolytes. The best nonaqueous electrolytes for lithium were found to be potassium hexafluorophosphate and lithium perchlorate in methyl formate. Results for tests for magnesium in nonaqueous electrolytes were erratic due to sensitivity to anode surface preparation. Several plots are given, along with circuit diagrams for the cells, and vapor phase chromatograms for several electrolytes. L.S.

N66-12176# Northrop Corp., Hawthorne, Calif. Norair Div.
PRELIMINARY DESIGN AND ANALYSIS OF A LIFTING RE-ENTRY VEHICLE REACTION CONTROL SYSTEM
W. F. Keller Mar. 1965 26 p refs
(NOR-65-38)

A preliminary design and analysis study of an M-2 Reaction Control System is presented. Included in the study is consideration of control requirements, total impulse, vehicle integration, reliability, optimum system design and component selection. Control accelerations of $\pm 3°/sec^2$ in pitch and $\pm 5°/sec^2$ in yaw

and roll appear adequate for the maximum control tasks. Total impulse is estimated to be 13,000 lb-sec, including 3,700 lb-sec for separation of the vehicle from the booster. A preliminary configuration includes redundant jets, providing 30 lbs of thrust in pitch, 60 lbs in yaw, and 30 lbs in roll (two jets in a couple). A bipropellant (Nitrogen Tetroxide/Monomethylhydrazine), ablative, reaction control system, optimumly designed to the vehicle and mission requirements, is estimated to weight 123 lbs. Substitution of the available, man-rated Gemini 25 lb and 85 lb units will increase this weight by about 15 lbs. Author

N66-12189*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STUDY OF DRIFT-FIELD SOLAR CELLS DAMAGED BY LOW-ENERGY PROTONS, SEPTEMBER 10–OCTOBER 15, 1965

J. DePangher, R. A. Breuch, and D. L. Crowther [1965] 23 p
(Contract NAS5-9627)
(NASA-CR-68159) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Current-voltage data, and spectral response data for 30 drift-field solar cells and 12 uniform solar cells irradiated by .221 kev, .470 kev, 1.04 Mev, and 2.53 Mev protons, were analyzed. A computer program was developed to fit the modified diode equation to four points on an I-V curve and to obtain completed I-V curves for the various irradiation energies. Degradation of all I-V curves with increasing proton fluence was evident. An analysis of I-V data obtained for solar cells irradiated by 1.04 Mev protons is given. G.G.

N66-12193*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STUDY OF DRIFT-FIELD SOLAR CELLS DAMAGED BY LOW-ENERGY PROTONS Progress Report, Jun. 15–Aug. 10, 1965

J. DePangher and E. A. Lodi [1965] 7 p
(Contract NAS5-9627)
(NASA-CR-68158) CFSTI: HC $1.00/MF $0.50 CSCL 10A

During the period June 15 through August 10, 1965 considerable effort was made to calibrate the irradiation apparatus and the counting equipment to find the cause of discrepancy in the calibration of the 60° and the 120° monitor for measuring proton fluences. Pulse height distribution data, uniformity data, and data obtained at different count rates are being analyzed. Solar cells were soldered to small copper blocks, and current-voltage curves as well as spectral response curves were obtained prior to the anticipated irradiation with 2.8 Mev protons. G.G.

N66-12196*# Allis-Chambers Mfg. Co., Milwaukee, Wis. Research Div.

A DIGITAL PROGRAM FOR DESIGNING MINIMUM WEIGHT FUEL CELL POWER SYSTEMS

Ramesh R. Desai Jun. 1965 113 p refs
(Contract NAS8-5392)
(NASA-CR-68125) CFSTI: HC $4.00/MF $0.75 CSCL 10A

This document presents an IBM-704 FORTRAN program to design minimum weight fuel cell power systems. For a selected power profile, i.e., power versus mission time, and voltage requirements; this program provides the significant parameters of a system. In addition, it permits computing design parameters for a combined fuel cell-battery system, where batteries supply power for peak loads. Author

N66-12265*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Equipment Labs.

BRAYTON CYCLE CAVITY RECEIVER DESIGN STUDY, JUNE 25, 1963–JUNE 15, 1965

22 Nov. 1965 308 p refs
(Contract NAS3-2779)
(NASA-CR-54752; ER-6497) CFSTI: HC $7.00/MF $1.75 CSCL 10B

Concept designs were developed for receivers and cavity maximum temperature control and aperture closure devices during a study of a Brayton cycle cavity receiver for a dynamic solar power conversion system. The receiver design has a 30-foot diameter rigid solar collector in a nominal 300 nautical mile earth orbit; with variations established for a 20-foot collector in a synchronous orbit. Effect of collector misorientation up to a maximum of 1/2-degree was studied, and parametric studies were conducted to determine effect of gas temperature rise and gas pressure drop. Thermal conductivity, heat input rates using extended surfaces, heat release rates, and melting and freezing characteristics were determined for lithium fluoride. Electric analog techniques to measure the result of simultaneous heat addition and extraction for tube sections were incorporated in a digital computer program to determine temperature, flux, pressure, volume, resistance, and heat transfer variables. Computer program results indicate that cavity reradiation losses are 0.55 to 0.65 less than blackbody radiation. M.W.R.

N66-12347*# Livingston Electronic Corp., Montgomeryville, Pa.

DEVELOPMENT OF A LOW TEMPERATURE BATTERY FOR SPACE PROBE APPLICATIONS Final Report, 24 Jun. 1964–23 Jun. 1965

William F. Meyers and George M. Armstrong [1965] 142 p refs
(Contract NAS3-6009)
(NASA-CR-54733) CFSTI: HC $4.00/MF $1.00 CSCL 10C

Seventy-two hour primary reserve ammonia cell operation over the temperature range +20° C to −73° C was accomplished with Mg/KSCN: $NH_3/HgSO_4$ cells by the partial replacement of potassium with magnesium ions, the addition of sulfur to the cathode, and the evaluation of numerous other variables. Operation was extended to 21 hours at −90° C through further study and modification of the ammonia electrolyte. It is believed that the primary limiting factor to wet stand in liquid ammonia batteries has been identified. Author

N66-12536# Library of Congress, Washington, D. C. Aerospace Information Div.

THE METHODS OF DIRECT CONVERSION OF ENERGY

G. V. Lashkarev and V. S. Fomenko 6 Dec. 1963 10 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Energ. i Avtom (Moscow), no. 4, Jul.–Aug. 1962 p 145–150 (AID-T-63-119-C; AD-621806)

Papers are presented on problems of direct conversion of energy by the magneto-gas-dynamic, thermoelectronic, thermoelectric, and chemical methods. Ten reports and communications were presented on the physical fundamentals, experimental results, and some problems of the theory and practice of designing various converters. TAB

N66-12715 Joint Publications Research Service, Washington, D. C.

ON V. A. PAVLOV'S NOTE "ON THE INFLUENCE OF THE ROTATION OF THE BASE ON THE DEFLECTION OF A GYROSCOPE IN AN INERTIAL SPACE"

N. V. Butenin and Ya. L. Lunts *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 94–96 refs (See N66-12701 03-14) CFSTI: $5.00

V. A. Pavlov's investigation of the motion of a gyroscope in a moving system of coordinates has been refuted, and a mistake in his calculation of the kinetic energy was indicated. Given is proof of the absence of deflection of the gyroscope axis in an inertial space during rotation of the base. R.C.S.

N66-12716 Joint Publications Research Service, Washington, D. C

ON THE THEORY OF A GYROSCOPE PENDULUM

A. M. Lestev *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 97–102 refs (See N66-12701 03-14) CFSTI: $5.00

In this article we consider the motion of a gyropendulum with dry and viscous friction in gimbal-ring supports, installed in a fixed position on the Earth. Author

N66-12717 Joint Publications Research Service, Washington, D. C.

ON THE EFFECT OF CONNECTIONS BETWEEN THE CHANNELS OF A GYROSCOPE PLATFORM

L. N. Slezkin and Tan-chih Wang *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 103–108 refs (See N66-12701 03-14) CFSTI: $5.00

In this article, with certain simplifying assumptions, the problem of the effect of cross connections between channels on the stability of a gyroscope platform is solved. Results of the modelling of transitional processes for specific examples are given. Author

N66-12718 Joint Publications Research Service, Washington, D. C.

ON THE STABILITY OF MOTION OF A GYROSCOPE LOCATED ON A MOVING BASE

A. N. Gurin *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 109–115 refs (See N66-12701 03-14) CFSTI: $5.00

This article presents a development for a case of a moving base. Besides this, the problem of the stability of a gyropendulum, whose gimbal centers are moving along the surface of the earth at a constant linear velocity, is solved. Author

N66-12719 Joint Publications Research Service, Washington, D. C.

A STAND FOR DEMONSTRATING GYROSCOPIC MOMENT

Y. Yu. Torochkov *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 116–118 (See N66-12701 03-14) CFSTI: $5.00

In this article we consider a device making it possible to demonstrate visually the appearance of gyroscopic moment and the change in loads in the supports of fast-rotating flywheels, installed on a rotating or oscillating base. Author

N66-12808# Rocketdyne, Canoga Park, Calif.

HIGH-ENERGY BATTERY SYSTEM STUDY Final Report, 1 Jul. 1963–30 Jun. 1965

J. Farrar, R. Keller, and M. M. Nicholson Ft. Monmouth, N. J., Army Electron. Command, [1965] 67 p refs *Its* Rept.-8 (Contract DA-36-039-AMC-03201(E))

(R-5405-8; AD-622818)

Lithium, magnesium, and aluminum were studied as anode materials in statistically planned experimentation. Calcium and beryllium were also examined during subsequent tests. Lithium emerged as the outstanding anode material with a mean open circuit potential of −2.71 volts vs Ag/AgBr, limiting currents exceeding 10 ma/sq. cm., and utilization efficiencies of approximately 100 percent. Two dozen solids were tested as potential cathode sq. cm. materials. At low discharge rates of 1 to 5 ma/sq. cm. BrCN, $CuCl_2$, and CuF_2 proved to be the most promising although performances were less favorable at higher current densities. Bromine and water showed the best prospect for attaining the performance goal although they can only be used in reserve systems. Propylene carbonate was favored as the electrolyte solvent for a lithium cell, with 0.03/ohm/cm being the highest conductivity value observed for organic aprotic electrolytes. Calculations show that BrCN, $CuCl_2$ or CuF_2 cathodes coupled with lithium anodes can meet the performance goals for this program. Author (TAB)

N66-12868*# Planning Research Corp., Los Angeles, Calif.

RELIABILITY ASSESSMENT OF THE GEOS A POWER SUPPLY

Charles E. Bloomquist and Donald B. Levinson 11 Oct. 1965 22 p *Its* Tech. Advisement Memo. No. 106-9

(Contract NASw-1180)

(NASA-CR-68184; PRC-D-1110) CFSTI: HC $1.00/MF $0.50 CSCL 10A

An analysis is presented which indicates that nearly all unit failure probabilities are negligible. This was based on an entensive failure effect analysis of the unit in question, and all of the assumptions in the numerical analysis were made in the direction of conservatism. The final result showed that the power supply is expected to perform 93.5 percent of the function. The fact that MIL-HDBK-217 failure rates were used in the calculations, gives the impression that the estimate is conservative (low). It is concluded that the power supply portion of the GEOS satellite is well designed from a reliability point of view. R.W.H.

N66-12870*# Borden Chemical Co., Philadelphia, Pa. Central Research Lab.

IMPROVED SEPARATORS FOR SILVER OXIDE–ZINC AND SILVER OXIDE–CADMIUM CELLS FOR SPACECRAFT APPLICATION First Quarterly Progress Report, 10 Nov. 1964–9 Feb. 1965

Helmuth L. Pfluger and Howard E. Hoyt [1965] 31 p refs (Contract NAS5-9107)

(NASA-CR-68227) CFSTI: HC $2.00/MF $0.50 CSCL 10C

A study has been made of the diffusion of silver oxide through separator membranes, using radioactive silver and an improved technique. Three different types of membrane behavior were found. (1) Membranes composed of methyl cellulose intimately mixed with carboxylated polymers took up only very small amounts of silver but allowed small amounts of silver oxide to diffuse through. (2) Membranes composed of cellophane or polyvinyl alcohol, or compositions containing large amounts of hydroxyethyl cellulose reduce considerable amounts of silver oxide to metallic silver, allowing relatively small amounts to pass through. (3) A film of "S-type" polymer was unique in that it showed very little tendency to either pick up silver or let it pass through. Exploratory experiments on copolymerization of methacrylate esters with acrylic acid indicate advantages in preparing these by hydrolysis of corresponding copolymers of methyl acrylate with methacrylates. A promising quadripolymer was made from methyl methacrylate, isoprene, acrylonitrile and acrylic acid. Author

N66-12925# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development.

RF SENSITIVITY OF ELECTROEXPLOSIVE DEVICES USED IN THE AGENA D SPACE FLIGHT VEHICLE. VOLUME I: LABORATORY TESTS Final Report

Paul F. Mohrbach and Robert F. Wood Apr. 1964 333 p refs Prepared for Lockheed Missiles and Space Co.

(F-B2118-1)

Thirteen types of electroexplosive devices were evaluated for sensitivity using direct current stimuli and radio frequency stimuli. The DC tests consisted of constant current sensitivity

dynamic resistance, thermal time constant, and prepulse studies. The primary object of this report is to present the RF susceptibility of initiators in accordance with Atlantic Missile Range (AMR) safety specifications. The examination of checkout procedures used on the Agena D vehicle shows that the RF sensitivity is the same as during installation. R.C.S.

N66-12991*# Hughes Research Labs., Malibu, Calif.
THEORY AND PERFORMANCE OF AUXILIARY DISCHARGE THERMIONIC ENERGY CONVERTERS
R. C. Knechtli and Marvin Fox Jun. 1962 39 p refs *Its* Res. Rept.-243
(Contract NAS3-1909)
(NASA-CR-68366) CFSTI: HC $2.00/MF $0.50 CSCL 10A

A theory of auxiliary discharge thermionic energy converters is presented. Using this theory, it is possible to predict a converter's current-voltage characteristics as functions of auxiliary discharge current, auxiliary discharge voltage, and geometry. It is also possible to predict the resistive voltage drop across the plasma as a function of load current. Auxiliary discharge converter current-voltage characteristics were measured with auxiliary discharge current and voltage as parameters. These measurements are presented and compared with theoretical predictions. Quantitative agreement between theory and experiment has been obtained so far. In particular, the relatively low auxiliary discharge currents and low auxiliary discharge powers observed in the experiments appear consistent with theory. Author

N66-12998*# Battelle Memorial Inst., Columbus, Ohio.
THERMAL-ENERGY-STORAGE SUPPORTING RESEARCH Interim Technical Report, 1 Apr.–30 Sep. 1965
D. P. Moak, comp. 31 Oct. 1965 62 p refs Prepared for JPL
(Contract NAS7-100; JPL-950978)
(NASA-CR-68369) CFSTI: HC $3.00/MF $0.75 CSCL 10C

Evaluation of 3BeO-2MgO and 4BeO-MgO-Al_2O_3 for use as thermal energy storage materials continued. Thermal expansion studies on both oxides were completed; results indicated that the binary oxide expands 23.8 per cent on melting and 31.8 per cent in going from room temperature to 1900° C. The ternary oxide expanded 26.6 per cent from room temperature to 2000° C and was only partially molten at this high temperature. The heat of fusion for 3BeO-2MgO was established as 370 cal per g. Compositional stability studies with tungsten, rhenium, and tungsten-25 w/o rhenium as potential container materials indicated that MgO in the binary and ternary compositions reacted preferentially with tungsten. A one-dimensional transient heat-transfer program was written to describe the heat-storage effect when the latent heat of fusion provides the heat storage capability. G.G.

N66-13054# General Electric Co., Pleasanton, Calif. Atomic Power Equipment Dept.
URANIUM OXIDE FUEL FOR NUCLEAR THERMIONIC CONVERTERS
L. N. Grossman, R. A. Ekvall, and H. W. Hill 1965 10p refs
(Contract AT(04-3)-189)
(Conf-650908-4)

The suitability of UO_2 as a nuclear fuel when in contact with tungsten, molybdenum, and W–25%Re thermionic emitters was demonstrated. Extensive furnace tests showed that tungsten at 1900° C, molybdenum at 1700° C, and tunsgten–25% rhenium at 2000° C are suitable emitter cladding materials for nuclear thermionic energy conversion. Compatibility was maintained for periods of thousands of hours. For molybdenum and tungsten, 10,000 hour testing was completed with no harmful effects. Cesium vapor at 4 torr was found to suppress fuel and cladding evaporation. Also, fuel stoichiometry was observed to be an important variable to control. E.E.B.

N66-13080*# Radio Corp. of America, Mountaintop, Pa. Special Electronic Components and Devices.
RESEARCH AND DEVELOPMENT STUDY ON IMPROVEMENT OF ADVANCED RADIATION RESISTANT MODULARIZATION TECHNIQUES Final Report, 15 May–30 Nov. 1964
18 Dec. 1964 18 p
(Contract NAS5-3812)
(NASA-CR-68545) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Wrap-around solar cells (both contacts on the back) have been successfully fabricated. These cells have a 5% greater active area than cells of the standard construction. Twenty 10 cell modules were constructed by sweating wrap-around cells to printed circuit boards. The resulting modules showed an overall increase in output power of 4% compared to a Nimbus type 10 cell module, which is made of standard solar cells. The demonstration of the feasibility of fabricating assemblies on a dielectric substrate with printed circuit interconnections can be extrapolated to the fabrication of large arrays, possibly square feet, as a single entity. Author

N66-13128*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN–OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS Quarterly Report, 1 Jul.–1 Oct. 1965
M. Klein and E. Findl 17 Dec. 1965 39 p
(Contract NAS3-2781)
(NASA-CR-54805; EOS-4110-QL-5) CFSTI: HC $2.00/MF $0.50 CSCL 10A

A 28 volt 600 watt hour, 34 cell unit was electrically and mechanically tested, and single cell tests were conducted to evaluate electrode-asbestos variations. The 34 cell 500 watt unit demonstrated electrical performance characteristics which exceeded the nominal design power levels. Power levels of 1300 watts at 25 volts were achieved. Electrode degradation, similar to that shown in single cell testing, was noted upon continued cycling. Capacity tests, using a simulated Voyager Lander power profile, were conducted, and watt hours of 700 were achieved. It was concluded that the successful cycling of the 34 cell 500 watt unit demonstrated the feasibility of a 34 series cell device. Single cell test results indicate the possibility of utilizing cyanamid electrodes with minor modifications as a solution to the limitations of existing oxygen electrodes. R.W.H.

N66-13157*# General Electric Co., Schenectady, N. Y. Research and Development Center.
ELECTRODEPOSITED INORGANIC SEPARATORS First Quarterly Report, 15 Apr.–15 Jul. 1965
[1965] 19 p
(Contract NAS5-9168)
(NASA-CR-68470) CFSTI: HC $1.00/MF $0.50 CSCL 10A

The objective of this program is to evaluate the use of thin electrodeposited films of calcium and magnesium hydroxides as separators in silver cadmium cells. The work during this quarter was directed at establishing the effect of processing parameters on deposition rate and film properties as well as conducting preliminary tests with cells to determine the effect of sterilizing cells at 145° C. The process studies showed that over the range of current densities investigated (100–200 ma/in^2) the calcium hydroxide films are more adherent than the magnesium hydroxide films. The calcium hydroxide films appear to be thermally stable in the presence of 31 percent by weight potassium hydroxide when exposed to 145° C for a period of 40 hours. Electrochemical performance tests employing silver electrodes with calcium hydroxide films have been started, but insufficient data have been generated at this time to draw any conclusions. Author

N66-13197# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
[STABILIZATION OF THE CURRENT IN TRANSISTORIZED POWER SYSTEM] [STABILIZZAZIONE DELLA CORRENTE IN SISTEMI DI POTENZA A TRANSISTORI]
M. Avaltroni and M. Coli 23 Mar. 1965 14 refs In ITALIAN *Its* Nota Interna No. 277
(LNF-65/9) CFSTI: HC $1.00/MF $0.50

The stability of the power supply was studied as a function of the parameters of the transistorized control bank and of the counteraction coil. An analysis is given of two possible control circuits in series to the feed load. Some of the results of measurements made on a prototype are reported. NSA

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-12177*# Naval School of Aviation Medicine, Pensacola, Fla.
EFFECTS OF PROLONGED CALORIC STIMULATION UPON OCULOMOTOR, VESTIBULOSPINAL, AND SEGMENTAL SPINAL ACTIVITY
Bo E. Gernandt, Makoto Igarashi, and Harlow W. Ades 24 Jun. 1965 19 p refs *Its* Rept. No. 2
(NASA Order R-93)
(NASA-CR-68266; NSAM-934) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The effects of prolonged caloric stimulation with hot (45° C) or ice water have been studied upon eye movements, vestibulospinal, and segmental spinal activity. Results demonstrate that continuous irrigation with water of extreme temperatures evokes, in addition to the effects upon cupular position by endolymphatic convection currents, an initial excitatory thermal effect shown by increased afferent firing, followed by a paralyzing effect upon vestibular sensorineural structures. In order to localize more specifically the site of action of thermal stimulation, experiments were carried out upon labyrinthectomized squirrel monkeys and monkeys with the three semicircular canals plugged. These results, and those obtained by recording the cochlear microphonic and neural components to click stimulation during maximal cold and warm irrigation of the ear, indicate the effect is upon the peripheral nerve fibers somewhere between ampulla and internal auditory meatus. Author

N66-12198*# Chicago Univ., Ill. Dept. of Biophysics.
ELECTRON MICROSCOPIC AND BIOCHEMICAL CHARACTERIZATION OF FRACTION I PROTEIN
R. Haselkorn, H. Fernandez-Moran, F. J. Kieras, and E. F. J. van Bruggen [1965] 17 p refs
(Grant NSG-441-63)
(NASA-CR-68099) CFSTI: HC $1.00/MF $0.50 CSCL 06B

High resolution electron micrographs of Fraction I protein from Chinese cabbage leaves have been obtained. The protein, which has ribulose 1, 5-diphosphate carboxylase activity, appears to be a cube with edge of about 120 Å. Substructure can be seen in individual particles, consistent with a model having 24 subunits, the number prescribed by the available physical and chemical data. Author

N66-12200*# Northrop Space Labs., Hawthorne, Calif.
INVESTIGATION OF PEROGNATHUS AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY Progress Report, 1 Jul.–30 Sep. 1965
J. J. Gambino and Lindberg [1965] 23 p refs
(Contract NASw-812)
(NASA-CR-68217; NSL-64-29-8) CFSTI: HC $1.00/MF $0.50 CSCL 06C

Pocket mice subjected to 1000 rad and 1500 rad whole body Co^{60} irradiation were sacrificed in the one week period following exposure. Histopathology of the intestinal mucosa was examined. Degenerative changes were noted within hours after irradiation, but regeneration of epithelial cells was prompt, and even at the 1500 rad dose level, was completed by about 7 days post-irradiation. Tritiated thymidine studies indicate that pocket mice have a villus transit time of 5.7 days for intestinal mucosa cells in contrast to 4.3 days and 2.1 days for germfree and conventional CFW mice, respectively. Data are presented on the growth and development of 26 individuals from 8 litters, 22 of which were the result of the first recorded matings of *Perognathus longimembris* in captivity. Semilogarithmic plots of body weight, total length, and lengths of tail, hind foot and ear showed polyphasic growth. All showed a four-part pattern with initial instantaneous percentage growth rates which varied from 4.4% for total length to 14.8% for ear Hind foot showed the most rapid growth, reaching near adult size by 20 days. Author

N66-12250*# Public Health Service, Washington, D. C. Biophysics Section.
REDUCTION OF BACTERIAL DISSEMINATION; GERMICIDAL ACTIVITY OF ETHYLENE OXIDE; REDUCTION OF BACTERIAL CONTAMINATION ON SURFACES Fifth Quarterly Summary Report
Nov. 1965 8 p
(NASA Order R-137)
(NASA-CR-68090) CFSTI: HC $1.00/MF $0.50 CSCL 06I

Progress is reported on the reduction of microbial dissemination from humans. Tests were made on one subject dressed in street clothing, dressed in a sterile surgical scrub suit including cap and socks, and dressed in sterile surgical scrub suit including cap, socks, and surgical mask. Preliminary data indicated that dissemination of viable microorganisms can be reduced by wearing a sterile, efficient surgical face mask. Also, methods for optimum contamination of surfaces with human microorganisms without laboratory seeding were investigated in studies on the reduction of bacterial contamination during exposure to conditions of 40% relative humidity at 50° C. Data on natural contamination of stainless-steel strips during exposure for 72 hr in an area of moderate activity and exposure for 1-hr in a dynamic exposure chamber are presented. Exposure in a dynamic exposure chamber in which human shedding is occurring appeared to be superior in that maximum microbial contamination of the surfaces occurs in a short period which is desirable in order to avoid natural selection. E.E.B.

N66-12263*# National Aeronautics and Space Administration, Washington, D. C.
RESTORATION OF CONTRACTILITY AND PROSPECTS FOR TRANSPLANTATION OF HUMAN AND ANIMAL HEARTS [O VOSSTANOVLENII SOKRATITEL'NOY AKTIVNOSTI I PERSPEKTIVAKH TRANSPLANTATSII SERDTSA CHELOVEKA I ZHIVOTNYKH]

S. V. Andreyev Dec. 1965 8 p refs Transl. into ENGLISH from Eksperim. Khirur. i Anasteziol. (Moscow), v. 8, no. 4, 1964 p 32–36
(NASA-TT-F-404) CFSTI: HC $1.00/MF $0.50 CSCL 06E

Experiments on the restoration of contractility of the human heart after death and the possible resumption of hemodynamics in the organism are reported, based on postmortem examinations of 397 human hearts. The bioelectric activity of the myocardium and the significance of macroergic compounds (ortho- and pyrophosphoric acids, lactic acid, creatine, arginine, etc.) for the myocardial metabolism were studied to obtain data on the possibility of transplanting human hearts. Restoration of contractility, up to 5 days after death and lasting for more than 15 days, was possible in all cases of undiseased hearts. Present obstacles to human heart transplantation (such as tissue or protein incompatibility, difficulty in rapid re-innervation, etc.) are discussed briefly, and prospects for future transplantations are based on successful biosynthesis of protein molecules and polymers, including the various amino acids, to be used in constructing an artificial heart without tissue incompatibility. Author

N66-12269# Joint Publications Research Service, Washington, D. C.
MOLECULAR BASIS OF MEMORY
V. L. Ryzhkov 10 Nov. 1965 16 p refs Transl. into ENGLISH from Priroda (Moscow), no. 7, 1965 p 2–10
(JPRS-32809; TT-65-33387) CFSTI: $1.00

A broad range of problems with respect to memory based on biological mechanisms are examined. Discussed are excitation of nerve fibers with changes in polarization of ions along the fiber; nucleic acid metabolism in nerve cells; and a protein synthesis mechanism of memory which involves DNA threads. Structural diagrams are presented for the formation of the mediator RNA, and for protein synthesis. In support of the protein synthesis mechanism, experiments on memory carryover in planarians dissected with subsequent regeneration are discussed. Also reviewed are experiments on the transmission of memory in salivary gland chromosomes of insects by administration of a hormone called ecdisone, secreted by insects. The effects of chromosome spiralization and antibodies on memory mechanisms are also considered. L.S.

N66-12271# Joint Publications Research Service, Washington, D. C.
CHANGE IN OXYGEN PRESSURE IN THE HEART MUSCLE DURING ASCENT AND ACCELERATION
Ye. A. Kovalenko and V. I. Korol'kov 29 Nov. 1965 refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 51, no. 8, Aug. 1965 p 966–973
(JPRS-33066; TT-65-33643) CFSTI: $1.00

Polarographic electrodes were implanted in the heart muscles of dogs in order to study changes in myocardial oxygen pressure during ascent and acceleration. Prior to ascent, cardiac contractions taken in a pressure chamber remained fairly constant and averaged about 145 per minute; this rose to an average of 191 after exposure to rising altitude conditions. Respiration rate rose from an average of 28 to 44 per minute. In all experiments oxygen pressure fell as altitude increased; temporary stays at 2, 4, and 6 km led to approximate drops of 85%, 73%, and 64%, respectively, from initial levels. With brief stays at 8 and 12 km, these pressures decreased to about 48% and 42% and were accompanied by sharp hypoxic disorders and marked disturbances in EKG. Myocardial oxygen pressure tends to rise during the initial action of overloads from rotation in a centrifuge, but later falls in the presence of 6, 8, 10, and 12 g overloads. Oxygen pressure falls more sharply during the third minute of rotation with overloads in the head-pelvis direction than with transverse overloads. M.W.R.

N66-12273# Joint Publications Research Service, Washington, D. C.
CERTAIN PHYSIOLOGICAL REACTIONS OF MAN UNDER CONDITIONS OF BRIEF WEIGHTLESSNESS
I. I. Kas'yan, A. S. Krasovskiy, I. A. Kolosov, M. A. Lomova, V. I. Lebedev et al 1 Dec. 1965 23 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, Sep.–Oct. 1965 p 633–646
(JPRS-33115; TT-65-33692) CFSTI: $1.00

Indices of physiological functions of 31 male subjects subjected to weightlessness conditions were recorded by means of miniature medical equipment attached to the subjects. Recordings were made of the bioelectric activity of the brain (EEG), of the heart muscles (EKG), of respiratory rates, and of vestibular coordination reactions in the initial state before weightlessness, during, and after. The physiological data obtained are tabulated, plotted, and discussed. L.S.

N66-12294# Joint Publications Research Service, Washington, D. C.
THE EFFECT OF MICROWAVES ON LIVING ORGANISMS AND BIOLOGICAL STRUCTURES
A. S. Presman 29 Nov. 1965 61 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 86, no. 2, Jun. 1965 p 263–302
(JPRS-33054; TT-65-33631) CFSTI: $3.00

Experimental and theoretical studies on the biological effect of microwaves are surveyed to familiarize physicists with the research reports published in biological and medical journals. Areas reviewed cover the electrical properties of tissues in the microwave band; absorption of microwaves in living tissues; reactions of animal organisms to irradiation with medium and high intensity microwaves; reaction of human and animal organisms to low intensity microwave irradiation; changes in animal tissues and organs caused by microwaves; effects of microwaves and electromagnetic fields of other frequencies on the cellular and molecular level; mechanism problems of the biological effect of microwaves and electromagnetic fields of other frequencies; reception and generation of electromagnetic fields in living organisms; and monitoring of microwaves to estimate their effect on people and in animal experiments. From the data, the assumption was made that the biological activity of electromagnetic fields is caused by the information interaction of these fields with the living organism, and not the conversion of electromagnetic energy into other forms. An extensive bibliography is included. M.G.J.

N66-12299# Joint Publications Research Service, Washington, D. C.
ANALYSIS OF THE EFFECT OF REPLACING NITROGEN BY HELIUM IN AIR ON THE DEVELOPMENT OF CHICK EMBRYOS
V. M. Savin, V. V. Rol'nik, P. A. Gul'tyayav, and V. V. Boriskin 17 Nov. 1965 13 p refs Transl. into ENGLISH from Biofiz. (Moscow), v. 9, no. 5, 1964 p 589–596
(JPRS-32905; TT-65-33482) CFSTI: $1.00

In studying the influence of prolonged replacement of nitrogen in the air by helium on the vital activity of an organism, experiments with chick embryos were conducted. Results show that normal development of the chick embryo was not prevented, when 99 percent of the nitrogen was eliminated from the atmosphere and replaced by helium. It was also found that heat removal by convection increased approximately two-fold, and moisture evaporation from the egg's surface intensified

by about 40 percent in the helium–oxygen medium. These phenomena were attributed to the peculiarities of the physical properties of helium. M.G.J.

N66-12345*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography with Indexes, Oct. 1965
Nov. 1965 142 p refs
(NASA-SP-1011(17)) CFSTI: HC $1.00/MF $1.00 CSCL 06S

N66-12346*# National Aeronautics and Space Administration, Washington, D. C.
METHOD OF DETERMINING THE PROPAGATION VELOCITY OF PULSE WAVES [K METODIKE OPREDELENIYA SKOROSTI RASPROSTRANENIYA PUL'SOVOY VOLNY]
V. P. Medvedev Dec. 1965 7 p refs Transl. into ENGLISH from Kardiologiya (Moscow), vol. 4, no. 1, 1964 p 79–82
(NASA-TT-407) CFSTI: HC $1.00/MF $0.50 CSCL 06P

The recording of the pulse-wave velocity with a loop oscillograph converting the mechanical vibrations of the arterial walls into electrical oscillations, is described along with a sketch of the experimental setup. The velocity of the pulse was obtained by dividing the length of the aorta by the time lag of the pulse from the femoral artery with respect to the pulse from the carotid artery. The sphygmograms were analyzed through a 5 × magnifier attached to the oscillograph. Author

N66-12371 Joint Publications Research Service, Washington, D. C.
HISTOCHEMICAL USE OF FRESH CUT TISSUE SHEET
Shih-Ho Chang, Hsiao-Mei Ch'en, and I-Yu Pao *In its* Transl. on Communist China's Sci. and Technol., No. 234 8 Nov. 1965 p 57–67 (See N66-12367 03-34) CFSTI: $3.00

The technique of freezing and cutting fresh tissue sheets is described in detail, as well as the design and manufacture of a low temperature cryostat with 58-cubic centimeter capacity. It is pointed out that the adoption of the Chinese-made cryostat in histochemical research has the following advantages: (1) Use is made of the same tissue block to be frozen for continuous sheet cutting in formulating many types of histochemical and biochemical methods, closely relating the transformation of cell forms and the various transformations in chemical and biochemical analyses. (2) The cutting is more even. (3) The temperature in the cryostat can be adjusted arbitrarily to be maintained at a constant level. (4) The mounted sheet or the covered sheets can be used to level the cut surface. R.R.D.

N66-12385# Battelle Memorial Inst., Columbus, Ohio.
STUDY OF FLUORESCENT EMISSION FROM THE CAT CEREBRAL CORTEX Final Report, Jan.–Aug. 1964
Richard M. Roppel and Arthur C. Peters Wright-Patterson AFB, Ohio, AMRL, May 1965 17 p refs
(Contract AF 33(615)-1206)
(AMRL-TR-65-88; AD-622273)

Experiments were conducted to investigate the existence of changes in fluorescence properties of the cat cerebral cortex during cortical and peripheral electrical stimulation. In anesthetized cats, the exposed cortex was illuminated with the light output from a monochromator and fluorescence changes were detected by use of a photomultiplier tube. Appropriate filters were used to prevent response of the photomultiplier to light from the excitation source. When electrical pulse stimulus of electroconvulsive intensity was applied by means of a wick electrode to the brain surface, there were observed signals of several millivolts amplitude from the photomultiplier tube interpreted as fluorescence changes. An interpretation is tentatively proposed which is based upon changes in relative proportions of oxidized and reduced pyridine nucleotide in the cortical tissue. Author (TAB)

N66-12387# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF ELEVATED INTRAPULMONARY PRESSURE ON RESPIRATION AND CIRCULATION [FUNKTSII ORGANIZMA v USLOVIYAKH IZMENENNOY GAZOVOY SREDY]
B. A. Botvinnikov, I. Sh. Ginzburg et al 17 Jun. 1965 72 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Lab. Evolyutsionnoy Fiz. (USSR), v 1, 1955 p 118–160
(FTD-TT-65-154/1+2; AD-620970)

The changes in respiration under elevated intrapulmonary pressure, which take the form of an initial respiratory arrest, a subsequent retardation of respiration rate, and disruption of the normal relationships of the time and character of inhalation and exhalation (activation and intensification of exhalation), result principally from stimulation of the vagus receptors located in the pulmonary tissue. The extent and character of the respiratory changes depend on the exhalation and inhalation pressure. The principal role in exhalation during respiration under pressure is played by the muscles of the prelum abdominale. The coordination of the functioning of the abdominal muscles and the true respiratory musculature during respiration under pressure is disrupted after bilateral vagotomy in the cervical region. At identical elevated intrapulmonary pressures the changes in circulation depend on the character of the pressure. In contrast to intermittent pressure, constant pressure causes more substantial circulatory disturbances, as manifested in a greater decrease in arterial pressure and a larger increase in venous pressure. TAB

N66-12419* Pennsylvania Univ., Philadelphia.
EXPLOITATION OF SPACE ENVIRONMENT FOR BIOLOGICAL RESEARCH
Allan H. Brown *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 10 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The NASA Biosatellite Program is reviewed, and some of the difficulties encountered by the experimenters are identified. The phases of the program are described as an attempt to detect a synergistic effect between weightlessness and radiation exposure; experiments on plant morphogenesis and observations of the rhythmic behavior of plant and animal materials; and a study of primate physiology. Details on each phase are given. The problems involved with the program are defined as: (1) the long lead time connected with a satellite experiment; (2) the unfamiliarity of most biologists with the engineering aspects of a satellite operation; (3) the frustrations experienced when piggy-back rides were flown on vehicles intended for other purposes; and (4) the reduction of the experimenter's responsibility for his own experiment. The unfavorable image of space research in biology is also mentioned, and the possibility that the Biosatellite Program may improve this image is advanced. M.G.J.

N66-12431# Brussels Univ. (Belgium). Laboratoire de Radiobiologie et de Biophysique.
THYMECTOMY AND RADIOCANCERS, NORMAL KARYOTYPE, CHROMOSOMAL ABNORMALITIES AFTER TRITIATED THYMIDINE IN THE MOUSE C57 BL/6 [THYMECTOMIE ET RADIOCANCERS, CARYOTYPE NORMAL, ANAMALIES CHROMOSOMIQUES APRES THYMIDINE TRITIEE CHEZ LES SOURIS C57 BL/6]

D. J. Mewissen and L. E. Lagneau Brussels, EURATOM, Sep. 1965 12 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-020-12 BIOB)
(EUR-2462.f) CFSTI: HC $1.00/MF $0.50

The incidence of tumors late-induced by X-rays was studied in mice which had undergone thymectomy and irradiation and then, in some cases only, grafting of an isogenic thymic lobe. Thymectomy has the effect not only of reducing the incidence of lymphosarcomata, as has been known for some time now, but also of that of numerous other tumors, notably hepatomata. The karyotype of mice is marked by forty chromosomes and very few spontaneous aberrations. At least six pairs are not telocentric while another pair contains a bilocular chromosome. In the mitotic chromosomes of mice injected at birth with thymidine tritiated with doses ranging from 0.5 to 2.0 mC/g, achromatic vesicular images are observed which are not superposed on the tritiated molecules detected by autoradiography. Author

N66-12451*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEMS OF RADIATION SAFETY IN SPACE FLIGHTS; PHYSICAL AND BIOLOGICAL STUDIES WITH HIGH-ENERGY PROTONS
Yu. G. Nefedov, ed. Dec. 1965 245 p refs Transl. into ENGLISH of the Monograph "Problemy Radiatsionnoy Bezopasnosti Kosmicheskikh Poletov; Fizicheskiye i Biologicheskiye Issledovaniyas Protonami Bol'shikh Energiy" Moscow, Atomizdat, 1964
(NASA-TT-F-353) CSCL 06R

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N66-12452* National Aeronautics and Space Administration, Washington, D. C.
CHARACTERISTICS OF THE RADIATION EFFECT UNDER SPACE FLIGHT CONDITIONS AND WAYS TO DETERMINE ADMISSIBLE RADIATION LEVELS
V. Ye. Dudkin, Yu. G. Grigor'yev, Ye. Ye. Kovalev, A. V. Lebedinskiy, S. V. Levinskiy et al *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 3–20 refs (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

An evaluation is presented on the characteristics of the radiation hazards under manned space flight conditions including the effects of primary cosmic radiation, radiation of solar flares, the Earth's outer and inner radiation belts, and other possible regions with high radiation in interplanetary space. As man under space flight conditions is also affected by overloads, changes of gas and chemical composition in the air medium of the manned cabin, and other factors characteristic of a sealed enclosed space, consideration is given to the effect of radiation on man's resistance to these environmental factors, the combined effect of these factors on radiation injury, and the individual radiosensitivity of man. R.N.A.

N66-12453* National Aeronautics and Space Administration, Washington, D. C.
DOSIMETRIC INVESTIGATIONS AND SHIELDING STUDIES USING THE SYNCHROCYCLOTRON OF THE JOINT INSTITUTE FOR NUCLEAR RESEARCH
V. P. Afanas'yev, Yu. S. Deyev, I. B. Keirim-Markus, Ye. Ye. Kovalev, S. S. Kuznetsova et al *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 21–54 refs (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

Synchrocyclotron studies in dosimetry and shielding are described. Studies are included on the physical conditions required for irradiating animals by high energy protons, methods for measuring fluxes and doses of high energy protons, determining tissue doses, protective properties of materials in the proton beam of a synchrocyclotron, and the radiation resistance of plastic materials. R.N.A.

N66-12454* National Aeronautics and Space Administration, Washington, D. C.
BIOLOGICAL EFFECT OF PROTONS WITH ENERGIES OF 510 MeV IN CASES OF MULTIPLE IRRADIATION
A. F. Bibikova, N. G. Darenskaya, M. P. Domshlak, A. N. Ganshina, G. K. Gerasimova et al *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 55–102 refs (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

The biological effects of high energy protons were studied in cases of multiple irradiation. Mongrel dogs, rats of the Wistar species, and mongrel white rats were used as experimental animals. Radiation effects on dogs were evaluated in the general state of the animals; condition of the peripheral blood and bone marrow; data from a biochemical study of the blood serum for total protein content, individual fractions, serum mucoid, and cholinesterase; state of the cardiovascular system; state of the oxidation processes; state of the nonspecific resist-

ance to infection; and pathologic-morphological and histological characteristics of the central and peripheral nervous systems, cardiovascular system, respiration, gastro-intestinal tract, and blood generating organs. Clinical, hematological, and pathologic-morphological analyses were made on the radiation injuries in rats. Details of methods used and results are discussed. R.N.A.

N66-12455* National Aeronautics and Space Administration, Washington, D. C.

BIOLOGICAL EFFECT OF PROTONS WITH ENERGIES OF 510 MeV DURING SINGLE IRRADIATION

A. F. Bibikova, N. G. Darenskaya, N. A. Derbeneva, M. P. Domshlak, A. N. Ganshina et al *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 103–141 refs (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

Studies were conducted on the biological effects of high energy protons during a single irradiation on mongrel dogs and white rats of the Wistar breed. Radiation effects on the dog's peripheral blood, cardiovascular system, gaseous interchange in a state of relative rest, immunobiological reaction, protein composition and cholinestrase activity of the blood serum, and pathology and morphology are described in detail. Rats were tested for effects on weight, peripheral blood composition, pathology and morphology, and their general clinical picture. The results of these investigations on radiation damage are also described in detail. R.N.A.

N66-12456* National Aeronautics and Space Administration, Washington, D. C.

BIOLOGICAL EFFECT OF PROTONS WITH ENERGIES OF 126 MeV ON CORNEAL EPITHELIA OF MICE

V. M. Mastryukova and A. D. Strzhizhovskiy *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 142–150 refs (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

A detailed account is presented of the methods used, data obtained, and the conclusive results of an investigation on the biological effects of high energy proton irradiation on the corneal epithelia of mice. It was postulated that genetically damaged cells possessing high reproductive viability are retained in the irradiated tissue for a long time and are responsible for tumors. R.N.A.

N66-12457* National Aeronautics and Space Administration, Washington, D. C.

DETERMINATION OF THE BIOLOGICAL EFFECT OF PROTONS WITH ENERGIES OF 510 MeV AND X-RAYS WITH ENERGIES OF 180 KV ON HEREDITARY STRUCTURES

Ye. D. Plotnikova and S. I. Strashnenko *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 151–156 refs (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

Investigations were conducted to determine the relative biological effect (RBE) of high energy protons on the hereditary structures of white rats. Dominant lethals were used as an index of hereditary changes caused by radiation. Unirradiated females were crossbred with irradiated males, sacrificed, and data derived which characterizes the frequency of dominant lethal development. The frequency increases with the radiation dose. An exponential dependence of this frequency on irradiation dose was noted. Values were obtained of the RBE for proton irradiation and compared to those previously derived for X-radiation. The RBE value was lower which may be due to the pulsating character of the proton radiation, whereas the X-radiation is continuous. It may also be the result of the interaction of high energy protons with tissue causing nuclear reactions which form "stars" with a high ionization density. It was noted that the RBE value is close to that obtained from a number of somatic reactions. R.N.A.

N66-12458* National Aeronautics and Space Administration, Washington, D. C

BIOLOGICAL EFFECT OF PROTONS WITH ENERGIES OF 130 MeV, X-RAYS WITH ENERGIES OF 180 KV AND CO^{60} GAMMA RADIATION ON THE VESTIBULAR APPARATUS

Yu. G. Grigor'yev, A. V. Sevan'kayev, and A. A. Sveshnikov *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 157–184 refs (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

Investigations were conducted on the character of functional changes of the vestibular apparatus under the influence of different doses of ionizing radiation from high energy protons and X-rays and cobalt-60 gamma radiation, and the possible subsequent change of the sensitivity of the vestibular apparatus to adequate irritants. Data were collected which characterize the influence of high energy protons on the vestibular apparatus, the dose dependence of the studied effects, and functional impairments of the activity of the semicircular canals during different periods of radiation sickness. The results of these experiments, conducted on rabbits and dogs, are discussed in detail. R.N.A.

N66-12459* National Aeronautics and Space Administration, Washington, D. C.

BIOLOGICAL EFFECT OF MULTIPLE X-RAY IRRADIATION WITH ENERGIES OF 180 KV COMPARED WITH PROTON IRRADIATION (DOSES AND TEMPORAL DISTRIBUTION)

N. G. Darenskaya, M. P. Domshlak, V. I. Grachev, and N. I. Ryzhov *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 185–193 (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

The relative biological effect of protons in fractional irradiation was determined by experiments with the corresponding irradiation of dogs and rats by X-rays with a production energy ot 180 kv. The condition of the animals (external appearance, motor and alimentary activity, state of skin and fur, state of the mucous membranes, weight, body temperature, etc.) and the state of the peripheral blood and cardiovascular system (maximum arterial pressure, arterial tone, propagation rate of the pulse wave, electrocardiography) were observed and pathologic–morphological and histological investigations were made of the tissues and organs. The results of these observations are described in detail. R.N.A.

N66-12460* National Aeronautics and Space Administration, Washington, D. C.

COMPARATIVE ANALYSIS OF BIOLOGICAL EFFECT OF PROTON RADIATION WITH ENERGY OF 510 MeV

N. G. Darenskaya, M. P. Domshlak, Yu. G. Grigor'yev, Yu. G. Nefedov, V. A. Razorenova et al *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 194–209 (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

The relative biological effect of proton radiation with an energy of 510 MeV was determined with a comparison of the collected data with materials characterizing the effectiveness of X- and gamma radiation. The admissibility of the comparison was ensured by adherence to spatial uniformity of the distribution of X- and gamma radiation in experiments made on dogs and white rats. This, in accordance with former data, permitted an analysis relating the effectiveness of proton radiation to the effectiveness of both X- and gamma radiation. Comparative characterization of the effectiveness was based on percentage survival and on the basis of a comparison of morphological changes in the organs and tissues, and also from the

depth and intensity of changes of individual physiological functions in animals subjected under identical conditions to the effect of proton, X- and gamma radiations. R.N.A.

N66-12461* National Aeronautics and Space Administration, Washington, D. C.

PROPHYLAXIS AND THERAPY OF RADIATION INJURIES CAUSED BY PROTONS

Yu. D. Balika, A. F. Bibikova, B. I. Lebedev, V. D. Rogozkin, and K. M. Znamenskaya *In its* Probl. of Radiation Safety in Space Flights Dec. 1965 p 210–238 refs (See N66-12451 03-04) CFSTI: HC $6.00/MF $1.50

The results of investigations of the therapeutic and prophylactic effectiveness of individual pharmocological materials and certain variants of protective therapeutic complexes showed that the best protection is provided by 5-oxytriptamin and a combination of cystamin with amigdalin. An antithemorrhagic effect of 5-oxytriptamin during proton irradiation was established. An effective protective-therapeutic complex was developed which consists of a minimum range of protective and therapeutic preparations used for the most part per os. Investigations on dogs revealed that this complex is extremely effective in fatal acute radiation injuries from multiple proton irradiations. However, the complex did not prevent the development of aplastic anemia from which the dogs eventually died. For this reason it will be necessary to develop effective methods for combating specific disorders developing a long time after irradiation by high energy protons. R.N.A.

N66-12462# Milan Univ. (Italy). Inst. of Pharmacology.

SIMULATED COSMIC-RAY IRRADIATION WITH 600 MeV PROTONS, VOLUME 1, PART 2

Antonio Pasinetti Geneva, CERN, Nov. 1965 118 p Sponsored by CERN and Natl. Res. Council of Italy
(HER/AP-2-65) CFSTI: HC $4.00/MF $0.75

Results of experiments on the biological action of artificial cosmic radiation (600 MeV protons) are presented. The data include observations of the behavior of animals after irradiation; determination of the weight of the body and certain internal organs such as the liver, kidneys, testicles, spleen, heart, lungs, and brain; and the quantitative variation of the red and white blood cells, and also of the leucocyte formula. Results of the observations are reported in tables and graphs. A second series of tables and graphs gives the experimental results calculated as percentages of variation in respect to the controls. The appendix includes a series of graphs showing the variations in body and internal organ weights as a function of the dose at various intervals after irradiation. R.N.A.

N66-12533*# Melpar, Inc., Falls Church, Va.

DETERMINATION AND MICROBIAL SURVIVAL OF CRYOGENIC WHOLE AIR SAMPLING CONDITIONS

Washington, NASA Dec. 1965 45 p refs
(Contract NAS5-9529)
(NASA-CR-354) CFSTI: HC $2.00/MF $0.50 CSCL 06M

Experiments were conducted to qualitatively determine the survival of eight species of microorganisms to shock wave exposure and subsequent cryogenic whole air sampling. The eight microorganisms chosen were *Cladosporium resinae, Aspergillus niger, Penicillium notatum, Bacillus globigii, Serratia marcescens, Clostridium pasteurianum, Nocardia asteroides,* and *Streptomyces griseus.* The physical conditions to which these microorganisms were subjected were chosen from those suggested by the design of an existing collector system to be used in sampling the dust content of the upper atmosphere. This system uses a low temperature metal surface which at high speeds condenses all the air in its path. From this it was assumed that successful collection of microorganisms would be dependent on their ability to survive near vacuum in the upper atmosphere, rapid heating in passage through the shock wave generated by the sampling vehicle, high speed impaction on the metal surface, rapid cooling to a few degrees K, and rewarming to room temperature and subsequent storage for a period of time. Results showed that the majority of the microorganisms survived the conditions of the shock wave and cryogenic collection. The only exception was *Serratia marcescens.* R.N.A.

N66-12581# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

SELECTIVE SUMMARY OF STUDIES ON THE FISSION PRODUCT INHALATION PROGRAM FROM JULY 1964–JUNE 1965

R. G. Thomas, ed. Sep. 1965 284 p refs
(Contract AT(29-2)-1013)
(LF-28) CFSTI: $3.50

A gamma ray detection system for biological samples that will yield good spectral data and be insensitive to changes in sample size is being investigated. In this system, the samples are rotated around an axis parallel to the axis of a long, cylindrical NaI detector. Data obtained to date on its response to 1 ml and 1 quart samples demonstrate that this system can be made insensitive to geometry changes of this magnitude while maintaining a usable counting efficiency (3% for Cs-137). Construction details are given. Work on the spectral response is still in progress. Author

N66-12592# Geoscience, Ltd., La Jolla, Calif.

THERMAL AND ELECTRICAL CONDUCTIVITIES OF BIOLOGICAL FLUIDS AND TISSUES Quarterly Report, Apr. 1–Jun. 30, 1965

H. F. Poppendiek, N. D. Greene, R. Randall, and P. M. Morehouse [1965] 15 p refs
(Contract Nonr-4095(00))
(GLR-37; AD-620916)

The results of several erythrocyte settling experiments in vertical and horizontal electrical conductivity cells indicated that removal of all cells from blood samples prior to the conductivity measurements insures removal of the settling parameter. Experimental time variations in the electrical conductivity of blood that had previously been cryogenically stored are noted to be small but as yet inconclusive. Comparison of conductivity results for plasma of blood that had been cryogenically stored with and without PVP additive were significantly different, the preserved blood having lower hemolysis and higher conductivity. The thermal conductivities of bovine brain, kidney, and liver were measured after these specimens were slowly frozen to 0° C and then slowly thawed; the conductivities increased approximately 10 percent above values obtained for corresponding unstressed specimens. The corresponding conductivity changes for samples that were cryogenically frozen and more quickly warmed were smaller. Anaytical thermal conductivity models were compared to experimental data obtained previously; good correlations of the results were obtained. Author (TAB)

N66-12607# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECTS OF X-IRRADIATION ON GASTRIC MOTILITY IN THE DOG

Jen-Pao Chu and Shou-Chien Shih 25 Jun. 1965 15 p refs Transl. into ENGLISH from Sheng Li Hsueh Pao (China), v. 24, no. 3/4, 1961 p 220–226
(FTD-TT-64-910/1+2+3+4; AD-620967)

Sublethal doses of x-irradiation did not have a pronounced effect on the motility of the empty stomach in dogs. The characteristic changes were increased strength of contraction and rapid recovery. A lethal dose of radiation caused a marked change in gastric motility. Immediately after the irradiation, gastric motility disappeared. Although the motility resumed subsequently, a sustained normal state was seldom reached. If the depression occurred, in most cases chances for full recovery were nil. In a few animals, after the first depression, the gastric motility fluctuated for several months before returning to normal. If, however, a second depression occurred after an extended normalization period, death usually followed. The extent of the gastric motility alteration may be used as an index to the severity of the radiation syndrome, as a basis for understanding of the nature of the gastrointestinal disturbance in radiation sickness, and eventually for its treatment. Since gastric motility is under the regulation of the CNS, its changes may also reflect the state of the CNS. Author (TAB)

N66-12626# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS OF COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 246. COLLECTED PAPERS OF THE FIRST NATIONAL SYMPOSIUM OF BIOCHEMISTRY
23 Nov. 1965 242 p refs Transl. into ENGLISH from the Document "Ti-i-Tz'u Ch'uan-Kuo Sheng-Wu Hua-Hsueh Hsueh-Shu-Hui Hui-K'an" Peking, 1962 p 1–84, 95–162 Symp. held at Shanghai, 15–22 Jan. 1960
(JPRS-33002; TT-65-33579) CFSTI: $6.00

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N66-12627 Joint Publications Research Service, Washington, D. C.
DEVELOPMENTS AND MISSIONS OF OUR COUNTRY'S BIOCHEMISTRY
Ying-Lai Wang *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 2–10 (See N66-12626 03-04) CFSTI: $6.00

An outline of the advances in biochemical research and development in mainland China during the last ten years is presented. Discussed are developments in basic theory, enzyme systems, metabolism, cancer, nutrition, and medical technology. L.S.

N66-12628 Joint Publications Research Service, Washington, D. C.
STRUCTURE AND FUNCTION OF PROTEINS
T'ien-Ch'in Ts'ao *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 11–87 refs (See N66-12626 03-04) CFSTI: $6.00

A detailed discussion of the chemical structure of the peptide chains of proteins is presented, with the aim of combining all known data for the purpose of finding a few roughly outlined rules governing amino acids of primary, secondary, tertiary, and quaternary structures. Tables giving the keys to the chemical structure of insulin, the tobacco virus, and other peptide chains are presented, along with a diagram showing the relationship between size and function of several extracted protein and polypeptide molecules. The discussion includes alpha helixes, the energy band theory of proteins, protein energy transmission mechanisms and semiconductor properties, protein toxins, microscopic differences in proteins, and enzymes. L.S.

N66-12629 Joint Publications Research Service, Washington, D. C.
PRESENT STATE AND OUTLOOK OF RESEARCH IN THE ENZYME CATALYSIS MECHANISM
Ch'eng-Lu Tsou *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 88–109 refs (See N66-12626 03-04) CFSTI: $6.00

Enzyme catalyst mechanisms are discussed. The lock and key, tension, induced fitting, and induced polarization theories of action mechanism are described; and the relationship between enzyme structure and catalytic activity is discussed along with a review of the formation of enzyme intermediate products. Considered are enzyme molecular weights, chemical changes in the molecular structure, the action of radical groups, activity centers, hydrolysis, inhibition by different amines, and optical rotation. A table depicting the catalytic effectiveness of enzymes listing the catalyst, the reaction, the temperature, and the second order reaction speed constant is given. L.S.

N66-12630 Joint Publications Research Service, Washington, D. C.
NUCLEIC ACID AND PROTEIN BIOSYNTHESIS
Te-Pao Wang and Wei-Lien Meng *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 110–124 refs (See N66-12626 03-04) CFSTI: $6.00

The biosynthesis of proteins by the incorporation of amino acids through a three stage process is discussed. Chemical structural formulas depicting the activation stage, the action of soluble RNA, and the incorporation step are represented. Results of experimental data in which amino acids were radioactively labelled are tabulated, showing the amounts of C^{14} amino acid incorporated. Other protein syntheses through bacteria are discussed, and the relationship between DNA and protein biosynthesis is also considered. L.S.

N66-12631 Joint Publications Research Service, Washington, D. C.

BIOENERGETICS

Ching-Hua Hsu *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 125–137 refs (See N66-12626 03-04) CFSTI: $6.00

A review of basic problems in bioenergetics is given. The excitation state of electrons, Kirkwood's theory of charge motion, hydrogen bonding, London-Van der Waal forces, and other electrical attraction forces are discussed with respect to possible forms of energy transformation in living organisms. Also discussed are thermodynamical relationships with life phenomenon, including entropy and energy barriers. L.S.

N66-12632 Joint Publications Research Service, Washington, D. C.

CONTRIBUTIONS OF MICROBIOCHEMISTRY TO BIOLOGICAL SCIENCES

Shan-Chiung Shen *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 138–142 (See N66-12626 03-04) CFSTI: $6.00

A review of microbiological and biochemical developments during the last 20 yrs is presented. Bacteria photosynthesis, intermediate catabolism, and nitrogen catabolism studies are discussed. Also discussed are induced enzyme studies with relation to biological synthesis of proteins, and heredity. In addition, studies involving N^{15} labelled DNA are described. L.S.

N66-12633 Joint Publications Research Service, Washington, D. C.

THE PRESENT TREND AND OUTLOOK OF COMPARATIVE BIOCHEMISTRY

Cheng Chi *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 143–165 refs (See N66-12626 03-04) CFSTI: $6.00

The significance, mission, and achievements of comparative biochemistry are discussed. A review of work on protein, purine, and amino acid metabolism is given. Tabulated data showing comparisons of N-excretions for vertebrates and nonvertebrates are given, along with other tables of data listing the end products of protein metabolism in animals; and abilities of man and animal organisms to synthesize amino acids. Nitrogenous bases and proteins with respect to muscle chemistry is also discussed; and tables listing nitrogenous bases in the muscles of different animals; phosphocreatine and phosphoarginine distribution in the animal kingdom; and differences in the methionine and cystine content of myosin of various animals are given. The use of the comparative point of view for studying various biochemical problems, including the distribution, structure, physico-chemical life mechanisms such as genesis growth, heredity, mutation, adaptation, etc. is advocated. L.S.

N66-12634 Joint Publications Research Service, Washington, D. C.

THE PRESENT STATE OF VIRUS RESEARCH

Shang-Yin Kao *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 166–180 refs (See N66-12626 03-04) CFSTI: $6.00

Activities in virus research are reviewed. The chamotherapy of viral infections; the biological control of crop pests with viruses; the infectivity and heredity of virus nucleic acids; and the growth, multiplication, and mutations of viruses are discussed. The present state of the art indicates that the relationship between virus mutation and the protein moiety is small, if any, though it is closely related to the nucleic acid moiety of the virus. A change in the nitrogen-alkali sequence of nucleosides appears to cause changes in virus biological characteristics. L.S.

N66-12635 Joint Publications Research Service, Washington, D. C.

BIOCHEMISTRY OF CONNECTIVE TISSUE

Shih-Chung Wang *In its* Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 181–203 refs (See N66-12626 03-04) CFSTI: $6.00

The components and metabolism of connective tissue are discussed from a biochemical viewpoint. The properties and chemical composition of fibrous proteins such as collagen, reticular protein, and elastin; nonfibrous proteins such as plasma albumin; acid mucopolysaccharides; and polysaccharides are discussed. The amino acid composition of several fibrous proteins compared with egg albumin, and an amino acid analysis of elastin and derived α and β proteins are listed in tabular form. The role of hyaluronic acid (and its isomer chondroitin), keratin sulfate, heparitin sulfate, and water in connective tissue is discussed. Also included is a diagram illustrating the biosynthesis of collagen. L.S.

N66-12636 Joint Publications Research Service, Washington, D. C.

BIOCHEMICAL PROBLEMS IN THE FOOD INDUSTRY

In its Transl. of Communist China's Sci. and Technol., No. 246 23 Nov. 1965 p 204–210 (See N66-12626 03-04) CFSTI: $6.00

Biochemical problems pertinent to food processing are reviewed. The problems of quality in raw materials, transportation, storage, processing techniques, and fortification and supplementation of color, smell, and taste are considered. Also discussed are the nutritional content of food, the utilization of raw materials and biochemical inspection methods. The use of enzyme preparations, vitamin preparations, plant bactericidins, and antibiotics for food processing is discussed, and ionizing radiation for sterilization is mentioned. L.S.

N66-12657# Joint Publications Research Service, Washington, D. C.

RECENT PAPERS DELIVERED AT VARIOUS SOVIET AND INTERNATIONAL CONFERENCES ON SPACE MEDICINE

10 Nov. 1965 51 p refs Transl. into ENGLISH from Soviet Rept. Presented at 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965
(JPRS-32808; TT-65-33386) CFSTI: $2.00

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N66-12658 Joint Publications Research Service, Washington, D. C.
PROBLEMS IN EVALUATING THE PERFORMANCE OF ASTRONAUTS
F. Y. Isakov, V. A. Popov, and L. S. Khachatur'yants *In its* Recent Papers Delivered at Various Soviet and Intern. Conf. on Space Med. 10 Nov. 1965 p 1–7 refs (See N66-12657 03-04) CFSTI: $2.00

Methods used and problems encountered in evaluating the performance of astronauts are described. The following methods are discussed relative to studying the ability of a human operator to perform under space flight conditions: graphic occupational analysis of the working operations; study of the resolving capacity of the visual analyzer; investigating visual operating capacity; the quality of the operative memory in working with the contours of regular and random lines; and study of dynamic features of a person in a modeling device control system with direct and delayed feedback. A brief consideration is included of the biomechanical analysis of the nature and features of the movements of Leonev during extravehicular activity. C.T.C.

N66-12659 Joint Publications Research Service, Washington, D. C.
RESULTS OF SOME ELECTROPHYSIOLOGICAL STUDIES ON THE "VOSKHOD" SPACECRAFT
I. T. Akulinichev, V. V. Bogdanov, D. G. Maksimov, and I. I. Popov *In its* Recent Papers Delivered at Various Soviet and Intern. Conf. on Space Med. 10 Nov. 1965 p 8–17 refs (See N66-12657 03-04) CFSTI: $2.00

A discussion is presented of some electrophysiological studies carried out on the Voskhod spacecraft. Such experiments as work capacity, fatigue, degree of motor coordination, and the retention of the motor stereotype developed under earth conditions are considered. The apparatus used in the experiments are described, and the method of transmitting the information is included. C.T.C.

N66-12660 Joint Publications Research Service, Washington, D. C.
CONFERENCE ON THE APPLICATION OF MATHEMATICAL METHODS IN AEROSPACE MEDICINE, 25–26 FEB. 1965
In its Recent Papers Delivered at Various Soviet and Intern. Conf. on Space Med. 10 Nov. 1965 p 18–48 (See N66-12657 03-04) CFSTI: $2.00

Summaries are given of reports delivered at a conference on the application of mathematical methods in aerospace medicine. Areas are considered such as: punched cards in the analysis of phonocardiographic data; apparatus for analyzing elicited responses; comprehensive analysis of electroencephalograms; a simplified method for measuring operator transfer functions; and the use of some statistical indices to find persons with latent forms of statokinetic disorders. C.T.C.

N66-12682 Mound Lab., Miamisburg, Ohio.
URINARY ELIMINATION FOLLOWING INHALATION OF INSOLUBLE PLUTONIUM OXIDE
W. E. Sheehan *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 39–46 ref (See N66-12676 03-06) CFSTI: $2.50 (Contract AT(33-1)-GEN-53)

From two inhalation exposure cases of plutonium oxide the urinalysis data indicate that DTPA treatments are the most effective from 100 to 300 days after exposure. Author

N66-12683 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
THE PHYSICAL PARAMETERS OF PARTICULATES WHICH EFFECT RESPIRATORY TRACT DEPOSITION
Robert G. Thomas *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 47–64 refs (See N66-12676 03-06) CFSTI: $2.50

Certain physical and physiological parameters which effect the pattern of deposition are reviewed. A cross section of the nasal-pharyngeal region which indicates the anatomical regions relating to the deposition of particles within the upper respiratory tract is shown. Also shown is a cutaway view of the respiratory tract below the larynx which indicates the various branches of the air passages. It shows how the relative size of the tubes decreases, starting with the first major bifurcation and passing through the main bronchi, upper and lower bronchi and down into the bronchioles in the extremities of the lobes. The humidity of the respiratory tract is extremely high, and at the pharynx and the larynx it reaches approximately 99.5% relative. If a dry hydroscopic particle were inhaled it would increase in size considerably while traversing the respiratory tract. Therefore, the site of deposition may be difficult to predict. The deposition pattern of NaCl as a function of the particle as it was measured in the dry state was also shown. R.W.H.

N66-12684 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
WHOLE BODY DEPOSITION OF PARTICLES AS A FUNCTION OF VARIOUS PHYSICAL AND CHEMICAL PARAMETERS
Randi Lie *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 65–75 refs (See N66-12676 03-06) CFSTI: $2.00

Investigations have shown that good correlation may be made between animals and man. A comparison between the rabbit and the rat of the mean uranium content of lungs at the time of terminal sacrifice following inhalation is given. The differences are small, especially with the smaller particle size. Also shown are comparisons of total retention between monkey and man, and between guinea pig and man. In both instances, the similarities are amazingly close. R.W.H.

N66-12685 Dow Chemical Co., Denver, Colo. Rocky Flats Div.
EFFECTIVENESS OF EARLY DTPA TREATMENTS IN TWO TYPES OF PLUTONIUM EXPOSURES IN HUMANS
C. R. Lagerquist, S. E. Hammond, E. A. Putzier, and C. W. Piltingsrud *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 76–84 refs (See N66-12676 03-06) CFSTI: $2.50

Two cases of plutonium exposure are reported. Both cases were given prompt DTPA (diethylenetriaminepentaacetic acid) treatments. In Case 1; an employee was sprayed with a plutonium nitrate solution. Plutonium entered his body via ingestion, inhalation, and absorption through small acid burns on the skin. In Case 2, an employee's thumb was pierced by a wire contaminated with plutonium oxide. The plutonium levels in their urine, feces, and blood were measured regularly. The effectiveness of the DTPA treatments was markedly different in the two cases. The DTPA was very successful in removing the soluble plutonium in Case 1. In Case 2, however, the effectiveness of the treatment was inconclusive. Author

N66-12686 United Kingdom Atomic Energy Authority, Harwell (England).

THE INTERPRETATION OF ANALYTICAL RESULTS FOR RADIONUCLIDES IN URINE

S. Jackson and G. W. Dolphin *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 85–101 refs (See N66-12676 03-06) CFSTI: $2.50

A brief summary is presented of the human data available on metabolism and excretion of cesium, phosphorus, plutonium, polonium, radium, strontium, sulfur, tritium and uranium. Following a recognized accidental intake of a radionuclide, it is desirable to analyze a carefully planned series of urine samples, to provide a measure of the excretion rate of the individual and to minimize the uncertainty association with single, isolated results. For assessment of routine urine analysis results from a group of personnel, the excretion data can be used to calculate the urinary concentration related to a chosen level of body content at which further investigation is required. Routine results should be carefully recorded for use in periodical reviews of their long-term significance. Author

N66-12689 Atomic Energy Commission, Washington, D. C.

PRELIMINARY RESULTS ON THE URANIUM CONTENT IN THE HUMAN DIET

George A. Welford and Ruth Baird *In its* Bioassay and Anal. Chem. Meeting [1964] p 136–141 refs (See N66-12676 03-06) CFSTI: $2.50

Human bone, tissue, and other organs of the body were analyzed and found to contain traces of uranium, usually less than 0.02 microgram per gram of organ. Measurable quantities of uranium in urine excreted by humans with no history of industrial exposure have been reported. These results vary but are usually less than one microgram per liter of urine. Several approaches to the isolation of uranium from a food and bone matrix were investigated. Several ion exchange techniques that separate uranium and iron using a mixed solvent system were also reported. R.W.H.

N66-12756 Joint Publications Research Service, Washington, D. C.

COMPARISON OF THE RADIATION SENSITIVITY OF CHROMOSOME IN WHITE BLOOD CELLS OF HUMAN BEINGS, MONKEYS, AND RABBITS

Hsien-Ting Chou *In its* Transl. on Communist China's Sci. and Technol., No. 244 23 Nov. 1965 p 45–50 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 10, Oct. 1965 p 917–918 (See N66-12751 03-34) CFSTI: $3.00

Blood from human beings, monkeys, and rabbits was used in an experiment to observe the chromosome mutation of white cells cultured in a short time as specimens. For men and monkeys, the blood was obtained from veins, and from hearts of the rabbits. As soon as the blood was obtained, it was irradiated with X-rays. The dosage was 0, 25, 50, 100, 200, and 300 rads, and the dose rate was 25 rads/min. The culture medium was a mixture of Eagle's solution and hydrolyzed lactoprotein, calf's serum, with a suitable amount of PHA and liver extract. From 100 to 300 cells were examined for each group of the experiment, and the results are given in tabular form. A comparison of the data between the variation analysis and the adjusted mean reveals that there is no great or distinctive difference in mutation values of chromosome between men and monkeys with respect to the dosage, but that there is a great difference between men and rabbits, and between monkeys and rabbits. C.T.C.

N66-12762# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF VESTIBULAR IRRADIATION ON ELECTRICAL ACTIVITY OF THE CORTEX AND BASAL AREAS OF THE BRAIN

Ye. A. Zhirmunskaya and F. M. Ioselevich 18 Aug. 1965 23 p refs Transl. into ENGLISH from Vestn. Oto-Pino-Laringol. (USSR) v. 13, no. 2, 1951 p 17–24
(FTD-TT-65-410/1+2+4; AD-620503) CSCL 06P

Relative investigation of electrical activity of cortex and basal sections of the brain revealed certain additional characteristics in the nature of basal electrogram in comparison with the previously described ones. Vestibular irritation causes considerably greater changes in bioelectric activity of the brain than do other afferent irritations. Electric response to irritation of the vestibular apparatus can be picked up from all areas of cortex cerebri and in a majority of cases appears to be two-sided symmetrical. Responsive reaction to vestibular irritation in basal areas is expressed much brighter, more intensive and longer lasting, than in the cortex cerebri. Duration and multiphaseness of changes in electrical activity of the brain during vestibular irritation, apparently, are connected with the involvement into responsive reaction of a series of mechanisms, including the vegetative-vascular. A very important role is played in this case by the emotional factor. The obtained data, indicating considerable functional displacements in electrical activity of basal sections of the brain under the effect of vestibular irritation in norm, give bases to assume that illnesses of the central nervous system the changed nature of its reactivity may be easier to detect with the aid of the mentioned afferent irritation. Author (TAB)

N66-12827# Army Chemical Center, Edgewood, Md. Chemical Research and Development Labs.

EFFECT OF PREVIOUS POSTURE ON CARDIAC ACCELERATION AT THE BEGINNING OF EXERCISE

F. N. Craig Mar. 1965 10 p refs
(CRDLR-3268; AD-621529)

Three subjects rested in the supine position, arose quickly, and ran for 1 min on a treadmill. Then they stood erect for 1 min and ran again. For the first 30 beats at the beginning of the run, their cardiac acceleration was greater after supine than after standing rest. The acceleration after supine rest then declined. The difference in cardiac rate arising from previous posture was insignificant for the last 30 sec of the run. Environmental temperatures were 18 degrees and 46 degrees C. The initial difference in acceleration was greater at the higher temperature. The distribution of blood between the chest and the periphery contributes to the differences in the degree of acceleration of the heart at the beginning exercise. Author (TAB)

N66-12885# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

COMPRESSION FRACTURES OF THORACIC VERTEBRAE APPARENTLY RESULTING FROM EXPERIMENTAL IMPACT, A CASE REPORT Final Report, Jan.–Apr. 1964

John H. Henzel, Neville P. Clarke, George C. Mohr, and Edmund B. Weis, Jr. Aug. 1965 13 p refs
(AMRL-TR-65-134; AD-622026)

The occurrence of compression deformities of the fourth and fifth thoracic vertebrae in a human test subject (DCL) exposed in laboratory experiments to an impact acceleration profile similar to that produced by ejection seat rockets is reported. This injury was presumed to be the result of an impact profile having a peak acceleration of 18.8G, a rate of onset of 420G per second and a baseline duration of approximately 100 milliseconds. The subject's long axis was inclined backward 34 degrees from the vertical force vector. The

diagnosis was established upon the subject's termination of hazardous duty and separation from the service, approximately one year after the presumptive data of injury. This documented injury represents a demonstrable endpoint in impact tolerance of a subject exposed to an acceleration environment which can be specifically described. Author (TAB)

N66-12898# Jefferson Medical Coll., Philadelphia, Pa.
[STUDIES ON METABOLIC RESEARCH] Annual Report
F. William Sunderman 15 May 1965 57 p refs
(Contract AT(30-1)-1397)
(NYO-1397-1)

Metabolic research studies reported include the development of an atomic absorption procedure for the quantitative determination of Ni in urine and other biological materials; a modification of the atomic absorption spectrometric procedure for use in measurements of vanilmandelic acid in blood samples from a patient with pheochromocytoma throughout the operative period for removal of the tumor; the development of a conductivity method for the estimation of electrolyte concentration in blood serum; the modification of a cryoscopic method for use in determining the freezing point of biological fluids; and the development of a method for testing the uniformity of concentration of gases in animal exposure chambers. NSA

N66-12899# Oak Ridge National Lab., Tenn.
COMPARISON OF VARIOUS METHODS OF RATE RECORDING
C. Craig Harris, M. M. Satterfield, P. R. Bell, and D. A. Ross [1965] 15 p refs
(Contract W-7405-ENG-26)
(ORNL-P-1383; Conf-650313-2)

Comparisons are made between the performances of conventional, true-average, and digital count rate meters. All three devices currently in use for count rate recording cause at least some distortion of the actual events. When the counting rate is high, all can be used properly. When it is low, none do a good job. At any counting rate the digital and true-average rate meters are slightly better than the conventional device. If the recorded trace of counting rate versus time is to be believed from any of the devices, the memory or time constant must be short enough so that statistical variations are shown on the recorded curve. However, these variations must not be so large that they totally mask real events. In this respect the digital and true-average count rate meters are superior to the conventional instrument. R.N.A.

N66-12903# Joint Publications Research Service, Washington, D. C.
INFLUENCE OF DIFFERENT GRADES OF HYPOXIA ON SENSITIVITY TO EPILEPTOGENIC AGENTS AND ON CERTAIN FUNCTIONAL PROPERTIES OF MOTOR FORMATIONS OF THE BRAIN
S. A. Dolina 29 Nov. 1965 12 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 51, no. 7, Jul. 1965 p 799–805
(JPRS-33056; TT-65-33633) CFSTI: $1.00

The dynamics of convulsive states of various origin, the excitability of motor zones in the cortex, and the effect of hypoxia on functional properties of motor formations of the brain stem are studied. The work was conducted on 267 male rats of the vistar line, 4–7 months old. Hypoxia was simulated in a pressure chamber by rapid rarefaction of the air. Carazol and electric stimulation of the cortex of the brain were used as convulsion causing agents. R.C.S.

N66-12917# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
A FORTRAN IV PROGRAM FOR THE EVALUATION OF POST-IRRADIATION SURVIVAL TIMES
James L. Leitch and Nancy S. Hagen Nov. 1965 41 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-573) CFSTI: $2.00

A Fortran IV computer program has been developed for the rapid evaluation of post-irradiation survival times in animals. It takes into account the "cage effect" between cages within the same experiment, a factor not covered by the Litchfield time-percent effect method of analysis. The program may also be modified for evaluating drug and toxicity studies and for extended (life span) studies on both experimental (treated) and normal (untreated) animals. The terms "protection ratio" and "protection value" are defined. A new standardization procedure to allow comparison of results from different experiments is outlined and designated "survival ratio". Four appendices give the list of the program, flow diagrams for the program and the subprogram, preparation of the data deck and an output from a single experiment as illustration to assist others who may wish to follow or modify this tool for their own use. Author

N66-12951# Iowa State Univ. of Science and Technology, Ames. Coll. of Veterinary Medicine.
CRITICALLY CONTROLLED INHALATION STUDY OF PATHOGENESIS OF NEODYMIUM OXIDE IN MICE AND GUINEA PIGS
Fred C. Davison and Frank K. Ramsey Jun. 1965 80 p refs
(Contract AT(11-1)-1170)
(COO-1170-4)

This experiment was designed to evaluate the effects of an aerosol of stable neodymium oxide (Nd_2O_3) of a known particle size range and concentration on the lungs, other major organs, blood and body weight of mice and guinea pigs when administered over various periods of time up to 120 days. Mice and guinea pigs exposed to concentrations of approximately 30 mg Nd_2O_3/meter^3 of air, in which about 60% of the mass was composed of particles less than 1 μ in diam, showed a gradual increase of neodymium in the lung as exposure time increased. This material was contained in macrophages in the alveoli and in the alveolar septa and was transported to the tracheobronchial lymph nodes. There were no granulomatous or other dramatic inflammatory reactions to the foreign material during the period of this experiment, and the other body organs which were evaluated histopathologically remained relatively normal. Changes in hematologic parameters were not remarkable. Author

N66-12957# Joint Publications Research Service, Washington, D. C.
PRINCIPLES OF SEGMENTATION OF THE SPEECH STREAM
N. I. Dukel'skiy 9 Nov. 1965 160 p refs Transl. into ENGLISH of the book "Printsipy Segmentatsiya Rechevogo Potoka" Moscow, Publishing House Acad. Sci. USSR, 1962 p 1–138
(JPRS-32790; TT-65-33368) CFSTI: $5.00

This book treats problems of segmenting the speech stream into elementary units. These units and their properties and interrelationships in the speech stream can help to reveal a number of patterns in the conversion of the information of a continuously variable speech stream into minimum discrete elements (phonemes). The results of the research are based on a considerable amount of data, which were obtained through the use of the latest methods of experimental phonetics, including methods of transplanting and splicing sounds which were developed independently. Author

N66-12972*# Naval School of Aviation Medicine, Pensacola, Fla.
THE EFFECTS OF ENVIRONMENTAL TEMPERATURE CHANGES ON THE EKG OF THE SQUIRREL MONKEY (SAIMIRI SCIUREUS)
Arnold Eskin and David C. Riccio 12 May 1965 16 p refs (NASA Order R-39)
(NASA-CR-68306; NSAM-926) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Electrocardiograms of four monkeys were recorded during exposure of the animals to air slowly heated 5° to 8° C above room level. Neither rectal nor skin temperature was affected. Deceleration of the heart and increase in T-wave amplitude under these conditions are noteworthy phenomena. As a control, EKG records for two of the monkeys were similarly recorded during exposure to slowly cooling air. Rectal temperature showed a very small change. Heart rate and respiration rate increased and T-wave amplitude decreased considerably.
Author

N66-13006# School of Aerospace Medicine, Brooks AFB, Tex.
SPACE RADIOBIOLOGY. TRAINING AND OPERATIONS: A CONCEPT
John E. Pickering Jun. 1965 15 p refs Presented at the 3d Intern. Symp. on Bioastronautics and the Exploration of Space, San Antonio, 18 Nov. 1964
(AMD-TR-65-2; AD-471731)

Public utterances clearly indicate that the United States plans to pursue scientific explorations in the infinite region of space for the expansion of knowledge and the betterment of mankind. The degree to which manned and unmanned systems will be used is conjectural at this time. Once, however, the utility of man is demonstrated for prolonged periods of time, truly proving cost effectiveness, then maximizing this flight experience and reusability requires a conservation of radiation dose. Dose schedules and rest schedules for in-space training, data gathering, application flights and space-oriented capabilities are discussed based upon the recurring requirement of a limited and highly-selected group of people-astronauts. Weekly doses for different regions of space are suggested along with finite recovery periods based upon the several mission profiles, ages of the crew members, as well as a combination of mission flying years and age. These doses are related to biological effects obtained from ten years of chronic exposure in animals. Author (TAB)

N66-13007# Public Health Service, Washington, D. C.
HEAT SYNDROME DATA FROM SELECTED HOSPITAL RECORD SURVEY Final Report
James Meyers, Mario A. Calonje, Paul S. Parrino, and Martha W. Snyder Dec. 1965 90 p
(Contract OCD-OS-62-100)
(AD-623578)

Statistical analysis of heat syndrome causes, both environmental and human factors, with preventive and alleviating suggestions for civil defense shelters of similar situations. Useful base for clinical evaluation, for physicians and other medical personnel in emergency situations. Author (TAB)

N66-13032# Joint Publications Research Service, Washington, D. C.
ON SOME PRINCIPLES OF MACHINE DIAGNOSIS
M. I. Anokhin 6 Dec. 1965 7 p Transl. into ENGLISH from the book "Metodologicheskiye Problemy Diagnostiki" Moscow, Tr. I-Go Mosk. Ordena Lenina Med. Inst. Imeni I. M. Sechenova, v. 37, 1964 p 185–191
(JPRS-33161; TT-65-33737) CFSTI: $1.00

The basic principles of mathematical logic and probability theory on which computers are based and their application in diagnosing diseases are discussed. In the diagnostic computer, disease symptoms are at first multiplied as variable and then grouped into syndromes and the figures on their rate of occurrence are multiplied, whereupon the median of both figures is derived. The a priori probability of a disease is used but because of the lability of an a priori probability and its contingency on many factors, it is used as a subjective component in the diagnostic computer. One other method of comparing probabilities is the logic of the phase interval. Here the sums of the squares of the probability of each disease are compared. This method alone cannot produce reliable results. Symptoms may be primary or secondary and the absence of a secondary symptom may be of no significance. That is why probabilistic logic is needed. In making its diagnosis, the computer eliminates all diseases in which the patient's symptoms are impossible by deterministic logic. A selection is made from among the remaining diseases by probabilistic logic. On the basis of the phase interval method, the previous findings are corrected.
R.N.A.

N66-13051# Presbyterian–St. Lukes Hospital, Chicago, Ill.
PERIPHERAL CIRCULATION AND BONE METABOLISM
[1964] 14 p refs
(Contract AT(11-1)-507)
(FID-21339)

Studies were made of the clearance rate of Ca^{45} following intravenous injection in adult dogs and studies of the blood distribution between marrow and bone. The arteriovenous differences as an indication of bone uptake of Ca^{45} was greater in the first minute and then decreased slowly during the experimental period. The average percent cleared was 53.35% of the isotope for the first 5 minutes and 47.08% for 10 min. The blood distribution was found to be from 7.1 to 20.6% in the marrow and the rest in the cortex. The bone uptake of Ca^{45} decreased continuously but was still measurable at the end of 12 hr. The average blood flow to the femur was 4.9 cc/min/100 gm of fresh bone and 3.1 cc/min/100 gm of fresh cortical bone. Average relative blood volume for cortical bone was 0.0189 cc/gm and for marrow was 0.634 cc/gm. The blood flow to the femur in dogs with unilateral femoral arteriovenous fistulae was also determined. The average blood flow values were 10.322 cc/min/100 gm of fresh cortical bone for the fistula side and 7.043 cc/min/100 gm of fresh cortical bone for the opposite side. The average difference in weight between femurs on the side of the fistula and the opposite side was 6.845 grams.
E.E.B.

N66-13061# Creighton Univ., Omaha, Nebr. School of Medicine.
Ca-45 AND Sr-85 METABOLISM IN MAN Final Progress Report, 1 May 1958–31 Mar. 1965
[1965] 13 p refs
(Contract AT(11-1)-587)
(000-587-2)

Progress is reported in studies of bone metabolism and derangements therein found in bone diseases of man in which ^{45}Ca and ^{85}Sr were used as tracers. An extremity counter utilizing a plastic scintillation detector was used in counting and data were analyzed by a computer. A technique was developed for calculation of the exchangeable Ca in a given 3-in.

segment as grams of Ca and of accretion as grams of Ca per day so that the absolute contribution of individual peripheral bone regions to the total body kinetic analyses can be derived. Results show that periarthritic bone usually has a higher initial uptake than normal bone, despite lower plasma specific activity, and the rate of fall of activity in arthritic bone is less rapid than in normal regions, indicating an increase in bone exchangeability and accelerated new bone formation in periarthritic bone. Data are summarized from Ca balance and ^{45}Ca kinetic studies in patients with osteoporosis; calcium metabolism studies in patients with combined central osteoporosis and peripheral rheumatoid arthritis; and metabolic balance and ^{45}Ca studies in normal subjects, hypopituitary dwarfs, hypopituitary adults, and an adult with active acromegaly. A list is included of publications resulting from these studies. NSA

N66-13089*# California Univ., Los Angeles. Brain Research Inst.

MONITORING BRAIN FUNCTION AND PERFORMANCE IN THE PRIMATE UNDER PROLONGED WEIGHTLESSNESS Final Report, 15 Aug. 1963–14 Aug. 1964

W. R. Adey and J. D. French [1964] 21 p

(Grant NsG-515)

(NASA-CR-68413) CFSTI: HC $1.00/MF $0.50 CSCL 06S

A summary is given of studies in the role of environmental stimuli in determining central nervous processes. These studies are then used as criteria for evaluating the changes occurring in the central nervous system of primates exposed to a weightless environment for prolonged periods. The use of computer analysis is discussed relative to the evaluation of electroencephalograms for studying a broad gamut of physiological states in the mammalian organism. The study objectives are outlined, and areas of further research are suggested. The physiological variables considered are: systemic and peripheral arterial blood pressure, venous blood pressure, brain PO_2, intracranial pressure, GSR, heart rate, respiration, muscle tone, eye movements, and reflexes. C.T.C.

N66-13095*# Melpar, Inc., Falls Church, Va.

DETERMINATION AND MICROBIAL SURVIVAL OF CRYOGENIC WHOLE AIR SAMPLING CONDITIONS Final Report, 27 Dec. 1964–27 Jul. 1965

[1965] 47 p refs

(Contract NAS5-9529)

(NASA-CR-68421) CFSTI: HC $2.00/MF $0.50 CSCL 06M

Experiments were conducted to qualitatively determine the survival of *Cladosporium resinae, Aspergillus niger, Penicillium notatum, Bacillus globigii, Serratia marcescens, Clostridium pasteurianum, Nocardia asteroides,* and *Streptomyces griseus* to shock wave exposure and cryogenic whole air sampling. The physical conditions to which these microorganisms were subjected were chosen from those suggested by the design of an existing collector system to be used in sampling the dust content of the upper atmosphere. This system uses a low temperature metal surface which at high speeds condenses all the air in its path. From this it was assumed that successful collection of microorganisms in the upper atmosphere would be dependent on their ability to survive near vacuum, rapid heating in passage through the shock wave generated by the sampling vehicle, high speed impaction on the metal surface, rapid cooling to a few degrees K, and rewarming to room temperature and subsequent storage. The study established that the majority of microorganisms survived the conditions of shock wave and cryogenic collection. The only exception was the doubtful survival of *Serratia marcescens.* R.N.A.

N66-13097*# Naval School of Aviation Medicine, Pensacola, Fla.

OTOLITH ORGAN ACTIVITY WITHIN EARTH STANDARD, ONE-HALF STANDARD, AND ZERO GRAVITY ENVIRONMENTS

Earl F. Miller, II, Ashton Graybiel, and Robert S. Kellogg 4 Aug. 1965 14 p refs Joint rept. with NASA *Its* Rept. No. 119 (NASA Order R-93)

(NASA-CR-68391; NSAM-943) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The objectives of the experiment are to measure otolith activity as indicated by ocular counterrolling (CR) response to body tilt within a force field of zero G, one-half and standard G, and to determine the effect of extralabyrinthine factors upon CR under these gravitational conditions. Six individuals with bilateral labyrinthine defects and seven normal persons served as subjects. Transient periods of subgravity force (0.5G, zero G) were produced by parabolic flight maneuvers in a specially equipped C-131B aircraft which accommodated a tilt chair and accessory apparatus for recording CR response upright and with body tilt ($\pm 25°$, $\pm 50°$). The labyrinthine-defective group revealed results qualitatively similar to those from the normal group but markedly reduced in magnitude. This demonstrated that extralabyrinthine factors were not significantly involved. In the normal subjects zero G induced a physiological deafferentation of the otolith organs. When the gravitational force equalled about 0.5G, CR was below the level midway between the zero and Earth standard gravity response. The nonlinear relationship between otolith activity and subgravity force is discussed. Author

N66-13165*# Public Health Service, Washington, D. C. Div. of Chronic Diseases.

A LONGITUDINAL STUDY OF NAVAL FLIGHT STUDENTS WITH PARTICULAR ATTENTION TO CARDIOVASCULAR DISEASE Progress Report No. 3, 1 Apr.–30 Sep. 1965

Samuel Fox et al [1965] 20 p

(NASA Order R-136)

(NASA-CR-68541) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The medical evaluation procedures carried out during the third follow-up of the "Thousand Naval Aviators" study are described. This study began in 1940 as an attempt to evaluate the significance of psychological and physiological variables in terms of success in naval aviation. In an overall evaluation of the program, it is pointed out that originally the physiological test findings had little predictive value for success in flight training and were largely forgotten. However degenerative disease become evident after many years, and repeated follow-up studies have endorsed the value of the early medical and physiological evaluations. The prediction is made that in future follow-up studies there will be a balance of interest on the part of physicians and of those in the behavioral sciences. M.G.J.

N66-13176# Joint Publications Research Service, Washington, D. C.

INVESTIGATING THE PHENOMENON OF SLEEP

A. Shepoval'nikov 25 Nov. 1965 6 p Transl. into ENGLISH from Izv. (Moscow), 29 Oct. 1965 p 6

(JPRS-33033; TT-65-33610) CFSTI: $1.00

Research on the mechanisms of sleep, and the use of electro-physiological methods for studying this phenomenon are reviewed. The encephalogram of a normally sleeping person is examined, and the consecutive changes shown by the recording of the biocurrents are discussed. It was found that during restful consciousness alpha waves, with a frequency of 10 vibrations per second, usually appear; light sleep is usually accompanied by frequency rhythms of about 14 vibrations per

second; further deepening of sleep shows the propagation of large slow waves, which gradually almost displace all other waves. It was noted that the internal deep sleep continues quietly for some time before the encephalogram changes sharply and approximates the pre-dormant period. This cycle, with its phases, is repeated until awakening. It is pointed out that sleep mechanism studies may prove useful for treating diseases connected with sleep disturbances, in investigating mechanisms, and for understanding the complex mechanisms at the basis of epilepsy. M.G.J.

N66-13209# School of Aerospace Medicine, Brooks AFB, Tex.
A NOMOGRAM RELATING Po_2, pH, TEMPERATURE, AND HEMOGLOBIN SATURATION IN THE DOG Technical Report, 1 Jul.–1 Dec. 1964
Robert G. Rossing and Stephan M. Cain Jun. 1965 15 p refs
(SAM-TR-65-39; AD-471848)

The data from 591 dog blood samples on which observations were made of Po_2, hemoglobin saturation, P_{CO_2}, pH, and temperature were analyzed by means of a digital computer. The Hill equation was found to fit the data well in the range from 20% to 98% saturation. Linear terms for pH and temperature effects were found to improve appreciably the prediction ability of the equation. A similar term for P_{CO_2}, although statistically significant, did not contribute enough additional precision in prediction to justify its inclusion in the final equations. The equations derived are:

$$\log(S/1 - S) = 2.5198 \log P_{O_2} + 1.1804 (pH - 7.0) - .047234T - 2.3621$$

and

$$\log P_{O_2} = .37143 \log (S/1 - S) - .48047 (pH - 7.0) + .019518T + .92247$$

A nomogram relating these variables is also presented.
Author

N66-13224# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TENTH CONFERENCE OF THE I. P. PAVLOV ALL-UNION PHYSIOLOGICAL SOCIETY, YEREVAN, 1964. VOLUME II: TOPICS OF SCIENTIFIC PAPERS, NO. 1
E. A. Asratyan, ed. 6 Jul. 1965 781 p Transl. into ENGLISH of the book "X Sbezd Vsesoyuznogo Fiziologicheskogo Obshchestva Imeni I. P. Pavlova, Yerevan, 1964 Tom II: Tezisy Nauchnykh Soobshcheniy, Vypusk 1" Moscow, Izd. "Nauka", 1964 479 p
(FTD-TT-65-47/1+2; AD-620050)

A compilation of papers presented at a physiological conference is presented. The more than 700 topics cover such areas as anatomy, responses, and organ functions of humans and animals. C.T.C.

N66-13245 Joint Publications Research Service, Washington, D. C.
METHODS AND INSTRUMENTATION SOURCES OF GAMMA-RADIATION IN A BIOLOGICAL EXPERIMENT
A. V. Bibergal 5 Nov. 1965 7 p refs Transl. into ENGLISH from Radiobiol. (Moscow), v. 5, no. 4, 1965 p 612–615
(JPRS 32704; TT-65-33218) CFSTI: $1.00

Gamma radiation apparatus used in biological experiments are described. The dosage range is given for each, and the areas of application are included. Equipment is considered for the irradiation of seeds before sowing, microbiological and radiochemical determinations, and chronic irradiations. C.T.C.

N66-13297*# National Aeronautics and Space Administration, Washington, D. C.
NOISE PROBLEM [PROBLEMA SHUMA]
I. Borshchevskiy and E. Lapayev Dec. 1965 8 p Transl. into ENGLISH from Aviats. i Kosmonaut., (Moscow), v. 48, no. 7, 1965 p 75–77
(NASA-TT-F-9799) CFSTI: HC $1.00/MF $0.50 CSCL 06S

A brief general review of the detrimental effect of noise of a certain intensity on the human organism, specifically on the auditory organs, is given, with diagrams on noise levels with and without engine exhaust silencers and descriptions of earplug and earcap designs. Hearing loss of flying crews in jet aircraft and spacecraft is considered transitory, while permanent damage is expected in unprotected maintenance crews. Soundproof rooms on airfields for rest periods of crews are suggested. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-12162*# Dunlap and Associates, Inc., Darien, Conn.
APPARENT MOVEMENT PHENOMENA ON CRT DISPLAYS: THRESHOLD DETERMINATIONS OF APPARENT MOVEMENTS OF PULSED LIGHT SOURCES
H. M. Bowen, L. L. Vallerie, F. J. Affinito, and J. G. Wohl Washington, NASA, Dec. 1965 31 p
(Contract NASw-954)
(NASA-CR-342) CFSTI: HC $2.00/MF $0.50 CSCL 05H

The "jump" phenomenon is due to stroboscopic interaction between saccadic eye movements (rapid movement from one fixation point to another) and pulsed light sources. The threshold for perception of a jumped image is primarily a function of the brightness of the pulse and the brightness of the background against which the jumped image is seen. In order to maintain high brightness of display, with a pulse brightness sufficiently low to avoid the jump phenomenon, PRF should be increased as far as possible. The "shift" phenomenon is believed to be due to stroboscopic interaction between small, involuntary eye movements and pulsed light sources. Experiments with the present equipment indicate that these effects are very small and, under the particular circumstances of the experiment, could not be seen by some observers. It is reasoned that special conditions (such as those existing on certain CRT displays) are required for the production of the shift phenomenon. Adequate investigation of the shift phenomenon therefore requires simulation of these conditions. Author

N66-12195*# Bell Helicopter Co., Fort Worth, Tex.
RESEARCH ON UTILIZATION OF PART TASK SPATIAL ORIENTATION INFORMATION IN THE DYNAMIC SIMULATOR
C. B. Elam and Billie A. Abbott Jun. 1965 86 p refs *Its* Tech. Rept.-299-099-284
(Contract NASw-439)
(NASA-CR-68219) CFSTI: HC $3.00/MF $0.75 CSCL 05H

Fifteen professional pilots and a like number of R.O.T.C. students were used as subjects in establishing the relative difficulty in controlling for pitch, roll, yaw and altitude when these parameters were presented in all possible combinations with one another. The Bell simulator was used with the Norden vertical display serving as the media for information transmission. Momentary error and control position were recorded and were later converted into error and inefficiency scores. While highly significant in a statistical sense, the differences between conditions were considered to be of limited theoretical interest. The primary contribution of the study was in its comparison of the different indices of error (absolute, squared and standard deviation) and the measures of inefficiency. It was concluded that the standard deviation is the most sensitive of the error measurements and that an index of inefficiency (product of the error and the rate of control movement) is more sensitive of error alone. Author

N66-12219* National Aeronautics and Space Administration, Washington, D. C

APPLICATION OF A DIGITAL COMPUTER TO MONITOR THE CONDITION OF A COSMONAUT AND LIFE-SUPPORT SYSTEMS

R. M. Bayevskiy, V. V. Bogdanov, L. A. Kazar'yan, V. I. Yazdovskiy, and A. M. Zhdanov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 116–122 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Human performance and life support systems in space are discussed in terms of automatic monitoring with a digital computer which can simulate clinical logic. Both systems aboard spacecraft and at ground stations are considered as is the selection of physiological methods to achieve automatic clinical control. Circuits are illustrated for a pulse channel, skin temperature measurement, and conditioned motor reaction. The automatic evaluation of the information received is considered. Characteristics are given for digital computer converters for the various clinical parameters under consideration. M.W.R.

N66-12220* National Aeronautics and Space Administration, Washington, D. C.

DATA PROCESSING SYSTEMS IN SPACE BIOLOGY

R. M. Bayevskiy, A. D. Voskresenskiy, O. G. Gazenko, A. D. Yegorov, N. A. Chekhonadskiy et al *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 123–130 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Investigative and control systems are differentiated in a discussion of data processing applications in space biology. The former involves the performance of the organism during space flight, while medical control is concerned with the collection of operational biological information to provide for flight safety. The mathematical simulation of reactions of the organism to factors during space flight is discussed, as are the technical problems associated with design of measuring, recording, and simulating devices. M.W.R.

N66-12221* National Aeronautics and Space Administration, Washington, D. C.

SENSORS FOR PHYSIOLOGICAL INVESTIGATIONS UNDER SPACEFLIGHT CONDITIONS

I. T. Akulinichev, R. M. Bayevskiy, O. G. Gazenko, I. S. Shadrintsev, and K. P. Zazykin *In its* Autom. Control and Methods of Elec. Meas. Vol. II Dec. 1965 p 131–138 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Methods of physiological investigations and types of sensors used in Soviet satellites are reviewed. Transformation of biological processes into electrical processes is accomplished by induction, piezoelectricity, and strain gauges. Sensors are also tabulated for the investigation of vegetative function, working capacity, and functional state of cerebral cortex. These include electrode, piezoelectric inductive, high frequency resistance, tachometric, rheostat, and contact devices. M.W.R.

N66-12222* National Aeronautics and Space Administration, Washington, D. C.

DESIGN OF AUTOMATIC EQUIPMENT FOR ANALYZING BALLISTOCARDIOGRAMS

K. P. Buteyko, N. G. Buryy, N. V. Vas'kova, A. K. Romanov, and I. I. Smirnova *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 139–146 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Sensor construction, calibration, and other aspects of design equipment are considered for the analysis of ballistocardiograms (BCG). Two methods are proposed for the analysis of BCG's, both of which can determine pathological variations in curves. Results graphed by the first method, based on the amplitude and duration investigation of the curves, compare BCG's of healthy people with those of persons exhibiting stenosis of the pulmonary artery, stenccardia, and mitral stenosis. The second method, in which the continuous curves are replaced by discrete values of amplitude, is selected because it requires less complex devices for processing the curves. At present, it is not possible to make specific diagnoses on the basis of BCG analyses; however, the curves do distinguish healthy from sick people. The proposed device may be used to accumulate data for future statistical analyses and to correlate distribution curves with types of illness. M.W.R.

N66-12376# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

PRELIMINARY STUDY OF DIAL READING PERFORMANCE DURING SUSTAINED ACCELERATION AND VIBRATION

Neville P. Clarke, Harvey Taub (Cornell Aeron. Labs., Inc.), Harris F. Scherer (NASA, Manned Spacecraft Center), William E. Temple, Hubert E. Vykukal (NASA, Ames Res. Center), et al Aug. 1965 16 p refs Prepared Jointly with NASA and Cornell Aeron. Labs., Inc.

(Contract AF 33(657)-11729)

(AMRL-TR-65-110; AD-622298)

Booster induced spacecraft vibrations occur in combination with booster induced sustained acceleration. This was a joint NASA–AF study to provide a preliminary cursory evaluation of the effects of this environment on crewmen. Six subjects were used in 60 tests to measure the decrement in dial reading ability as a function of the level of 11 cps gx vibration and the size of the dial, where a bias acceleration of 3.85 Gx was superimposed on the vibration. Dial reading errors were inversely related to the arc length of the interval between dials and directly related to the amplitude of vibration. There was approximately 50% distortion of the 11 cps vibration acceleration, which markedly influences the interpretation of results and their comparison to measurements of visual decrements from 11 cps vibrations with 1Gx bias loads. In most general terms, however, the 3.85Gx bias, and/or the undirectional force (i.e., the resultant acceleration was always greater than 0 G) creates a subjectively more tolerable environment than with a 1 G bias. Vibrations of 3.85Gx 13.0gx were without serious subjective effects in exposures of 90 seconds duration. Gross comparisons of dial reading performance under the two conditions provide some indication that the greater bias acceleration is associated with less visual decrement. Author (TAB)

N66-12380# Naval School of Aviation Medicine, Pensacola, Fla.

A STUDY OF STATEMENT ATTRACTIVENESS INDICES OBTAINED UNDER PERSONAL AND SOCIAL ORIENTATIONS

Lawrence K. Waters Jul. 1965 8 p refs
(NSAM-937; AD-622285)

Two indices for matching items on forced-choice scales for use with cadet groups were evaluated. Index deviation values for two indices of statement attractiveness, stressing either the personal or social acceptability of the statements, were correlated with each other, with four other attractiveness indices obtained previously, and with frequencies of statement choice obtained under four response sets. The correlation between the two indices and their relationship to previously obtained attractiveness indices and choice frequencies indicated the personal and socially oriented indices represented essentially the same attractiveness dimension for the cadet groups. The dimension appeared to be one of general desirability as contrasted to specific job (training program) desirability. Author (TAB)

N66-12444# Joint Publications Research Service, Washington, D. C.

COMBINATION OF WAVEMETER AND INTEGRATOR FOR SIMULTANEOUS EVALUATION OF QUANTITATIVE WAVE PATTERNS AND MEAN AMPLITUDE OF BRAIN POTENTIALS

A. M. Mitskis 29 Nov. 1965 5 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 51, no. 7, Jul. 1965 p 893–894
(JPRS-33055; TT-65-33632) CFSTI: $1.00

In this analytical method, the combined use of an integrator and wavemeter is proposed for convenient and constant recording of the brain potentials over an extended time period. The integrator is used to determine changes in the mean amplitude of brain potentials; the wavemeter counts the extremes of a random process. The quantity of marks by the integrator and wavemeter is plotted on the coordinate system, where the time is designated on the axis of the abscissa and the value of the mean amplitude and quantity of wave on the axis of the ordinate. Changes in the mean amplitudes and quantities of waves, and their mutual relationship, are presented in compressed and convenient form for quantitative evaluation. It is pointed out that this combination method gives a broader idea of approaching changes than the use of the integrator alone. A schematic of the wavemeter is included. M.G.J.

N66-12576# California Univ., Livermore. Lawrence Radiation Lab.

HAZARDS CONTROL Quarterly Report No. 21, Apr.–Jun. 1965

S. Block et al [1965] 39 p refs
(Contract W-7405-ENG-48)
(UCRL-14351) CFSTI: $2.00

Studies in controlling or eliminating radiation hazards are presented. It is reported that a small portable, lightweight, battery operated, continuous beta air monitor was built which can detect one MPC of I^{131} in 10 minutes. Also, a solid state plutonium air monitor was designed which uses transistorized circuitry. Results are discussed in an experiment to determine the sensitivity of a personnel monitoring film to 14 MeV neutrons. Preparation and studies of stimulated luminescence dosimeters and the results of different sulfides are described. In an investigated cleaning technique for silver metaphosphate glass, it was found that a triple rinse of dilute HCl, water, and methanol successfully removes surface soil and improves the consistency of the readings. In order to obtain satisfactory samples for radioactivity measurements, grass was compressed to densities of about 1 g/cc. Included are brief discussions in such areas as ventilation improvements for chemistry fume hoods and fire hose friction losses. C.T.C.

N66-12582# AiResearch Mfg. Co., Los Angeles, Calif.

APPLICATION OF RADIOISOTOPES TO MANNED SPACECRAFT LIFE-SUPPORT SYSTEMS. VOLUME I: TECHNICAL Summary Report

G. D. Davis, ed. Jul. 1965 334 p refs
(Contract AT(04-3)-575)
(SAN-575-12; SS-3369) CFSTI: $7.14 per set (2 vol.)

This report presents the results of a study of potential applications of radioisotopes to the operation of spacecraft life-support systems. Planned spacecraft missions and the life-support system processes they require are discussed. The integration of radioisotope thermal sources into the specific process functions is analyzed, and weight comparisons, are made between isotope energy systems and systems operated by fuel cells and solar cells. Studies were made of radioisotope selection and design considerations, and tradeoffs were made between single source and multiple source systems. Detailed studies are presented on the applications of isotopes to the processes of carbon dioxide removal, refrigeration, water and oxygen recovery, spacecraft heating, contaminant control, biological systems, and lunar material processing. The program has determined that isotope heating shows considerable promise in extended spacecraft missions for the processing of water, the regeneration of the spacecraft atmosphere, vehicle heating, and decomposition of solid wastes. Author

N66-12650 Library of Congress, Washington, D. C. Aerospace Technology Div.

HIGHLIGHTS OF SOVIET BIOASTRONAUTICS AT THE 16TH IAF CONGRESS

Boris N. Mandrovsky *In its* Foreign Sci. Bull., Vol. 1, No. 11 Nov. 1965 p 38–48 refs (See N66-12644 03-34)

Twelve Soviet papers dealing with biosstronautics, life support systems, and the Voskhod-2 flight which were presented at the 16th IAF Congress in Athens are examined. Despite the fact that the Soviet contributions were generally disappointing, they did help to clarify some details regarding the Voskhod-2 flight, they revealed Soviet concern over the effects of accelerations following weightlessness, and they provided some indications of research trends and some clues to probable future spaceflight plans. Author

N66-12728# Joint Publications Research Service, Washington, D. C.

CYBERNETICS IN MEDICINE

I. I. Pogromskiy 11 Oct. 1965 10 p Transl. into ENGLISH from Zdravookhr. Turkmenistana (Ashkhabad), no. 7, Jul. 1965 p 3–8
(JPRS-32344; TT-65-32834) CFSTI: $1.00

The development of cybernetics is reviewed, and the concepts given to the term by various scientific specialties are defined. The cybernetic devices used in medical practice are classified as: (1) biological control—devices based upon the use of information received from the living organism; (2) biological stimulation—devices designed for introducing control information into the living organisms, and (3) functional prosthesis development—devices replacing individual organs or functional systems and having an autonomous control system which is the isomorph to the corresponding system in the living organism. Consideration is also given to the brain and the nervous system as cybernetic systems, and the scientific discipline of neurocybernetics is discussed. Recommendations

are made on the application of cybernetics to diagnostics; these include devising algorithms for collecting and processing information, research on the statistical and probability distribution of medical data, and establishing the logical bases of diagnostics. M.G.J.

N66-12752 Joint Publications Research Service, Washington, D. C.
THE DEVELOPMENT OF CYBERNETICS
Shih-Hua Hu *In its* Transl. on Communist China's Sci. and Technol., No. 244 23 Nov. 1965 p 1-16 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 10, Oct. 1965 p 862-869 (See N66-12751 03-34) CFSTI: $3.00

A general discussion of the development of cybernetics deals with three general questions. (1) What is the background for cybernetics and how was this science used to suit the needs of society? (2) How did cybernetics expand into its various research fields? (3) When did cybernetics begin to produce practical and meaningful machines? M.W.R.

N66-12783# Dartmouth Coll., Hanover, N. H.
[AFFECTIVE COMMUNICATION IN SPEECH AND RELATED QUANTITATIVE PROBLEMS] Final Report, 15 Apr. 1963-14 Apr. 1965
Victor E. Mc Gee 26 Jul. 1965 58 p refs
(Contract Nonr-3897(05))
(AD-620333)

The research project was designed to investigate by various means those kinds of information in speech which do not deal directly with the actual verbal message per se. The name given to this nonverbal information is 'affective information'. The work attempted to make use of the physical information in the speech processing system to predict the 'intelligibility' of the speech signal. Intelligibility as here defined is synonymous with fidelity of transmission since the subject's response is merely a repetition of the perceived input signal. With respect to affective information the goal has been to identify as far as possible the acoustical properties of the speech signal which are identified with various perceptual responses to that speech signal. The first non-verbal aspect that was considered was 'speech quality'. Since this concept is of considerable importance both in the technology of speech processing developments and from a psychological point of view, various attempts at defining psychoacoustical correspondences have been made during the term of this project. (TAB)

N66-12959*# American Inst. for Research, Pittsburgh, Pa. Inst. for Performance Technology.
HUMAN FACTORS INFORMATION REQUIREMENTS FOR SPACE SYSTEM DEVELOPMENT Final Report
James W. Altman Jun. 1964 173 p refs
(Contract NASr-194)
(NASA-CR-68230) CFSTI: HC $5.00/MF $1.00 CSCL 05E

As a basis for projecting long-term requirements for human factors information in space system development, practices in existing programs were surveyed. Personal interview comments were supplemented by a literature survey and an analysis of system development decisions. A total of 74 individual requirements were identified, which can be summarized as: (1) basic data generation and dissemination—data concerning human functioning, improved availability of technical reports, development of a data storage and retrieval system, and techniques for establishing research priorities; (2) definition and control of the human factors process—improved communication between human factors and other personnel, the role of skilled operators, and integrated procedures on program planning and control; (3) function description and processing—function allocation, system, function, and task analysis; and job design and personnel forecasting; (4) human factors design—human engineering requirements; selection, training, and proficiency assessment; and informational job performance aids; and (5) design assessment—human factors evaluation and testing. Findings indicate the importance of rapprochement between theory and application. M.G.J.

N66-12989*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.
PROBLEM SOLVING STRATEGIES IN PARALLEL RESEARCH AND DEVELOPMENT PROJECTS
Thomas J. Allen Jun. 1965 27 p refs *Its* Working Paper No. 126-65 Sponsored by NASA
(NASA-CR-68375) CFSTI: HC $2.00/MF $0.50 CSCL 05A

Three pairs of parallel R & D projects are examined. The data analyzed were gathered by means of Solution Development Records—a form which provides a weekly estimate of the probability of adoption of the approaches under consideration as possible solutions to a technical problem. It is found that the longer an approach is indicated by these forms to be in a favored position, the more difficult it is to reject. Furthermore, the number of alternative technical approaches considered bears a relation to judged solution quality. Groups producing higher-rated solutions generated fewer approaches during the course of the project, and they more closely approach an ideal strategy of approaches off on a two-at-a-time basis than do their poorer performing rivals. Author

N66-12994*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.
CONTINUITY AND OPENNESS IN HIGH ENERGY PHYSICS GROUPS
Henry B. Eyring Sep. 1965 24 p refs *Its* Working Paper No. 142-65
(Grant NsG-235)
(NASA-CR-68303) CFSTI: HC $1.00/MF $0.50 CSCL 05S

Effects of organizational affiliation on high energy physics research groups were studied with emphasis on the following structural variable: whether the groups were composed of members from one organization or from more than one. It was found that both, group structure and openness of the group to take in new members, were related. A greater continuity of research relationships and an easier entry by newcomers might be achieved by encouraging formation of multi-organizational groups. Sub-groups tended to be more constant than single-organizational groups, and more constant single-organizational groups were less open. It was concluded that continuity and openness of a research group will require the categorizing of research tasks. G.G.

N66-13114*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Equipment Labs.
CARBON DIOXIDE CONCENTRATION SYSTEM Interim Report No. 1
A. D. Babinsky, D. L. De Respiris, and S. J. Derezinski 30 Nov. 1965 48 p
(Contract NAS3-7638)
(NASA-CR-54849; TRW-ER-6661-1) CFSTI: HC $2.00/MF $0.50 CSCL 06K

The preliminary analysis has been completed for design, fabrication, and testing of a life support system utilizing the TRW-developed "Carbonation Cell" system of extracting CO_2 from cabin air. Stages I and II of this electrochemical carbon dioxide concentration system have been designed and fabricated. The cells use electrodes measuring 12" by 12", and plated

magnesium end plates. Materials compatibility studies have also indicated the 2-mil non-porous gold plated magnesium is a suitable material to use in the third stage acid electrolyte cell. However, considering its prohibitive cost, plastic (PVDC) cells will be used for this program. These stage III cells are being designed. A test rig for small cell testing was assembled and has been used for testing of small acid stage cells. Additionally, a small carbon cell and a gold plated magnesium cell are being fabricated and assembled for use in this test rig. Design of a large test stand is completed for testing the full scale electrochemical cells, and assembly and checkout also are in progress at this writing. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-12275# Mound Lab., Miamisburg, Ohio.
[RADIOELEMENTS; ISOTOPE SEPARATION AND PURIFICATION; ANALYTICAL METHODS] Progress Report, May 1965
J. F. Eichelberger, G. R. Grove, and L. V. Jones 29 Oct. 1965 33 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1266) CFSTI: $2.00

Basic and applied radiochemical research on radioelements francium-223, polonium-209, polonium-210, and actinium-227 was conducted. Alpha emission, decay, isotopes, and chemical homologs were studied. Methods of isotope separation and purification; and methods of analysis, both by instrumental and standard wet techniques are developed. The half-life of francium-223 was measured by counting and resulted in a determination of 22.02 ±0.02 minutes. Preliminary measurements on polonium-209 indicated a half-life of less than ten seconds. A rapid and accurate method for estimating the polonium-210 content of process solutions, involving sorption of the radioelement of an anion-exchange resin followed by gamma counting after elution of interfering radioisotopes, was developed. Traces of actinium-227 are being recovered from process wastes, in a preparation of the radioelement by a cation exchange technique. Other work in isotope separation and purification for carbon, argon, krypton, xenon, and oxygen are also reported. L.S.

N66-12276# Pratt and Whitney Aircraft, Middletown, Conn.
THERMODYNAMIC PROPERTIES OF URANIUM MONOCARBIDE
P. A. Vozzella and M. A. De Crescente 27 Sep. 1965 21 p refs
(Contract AT(30-1)-2789)
(PWAC-478)

Uranium monocarbide was found to lose uranium preferentially in the temperature range 2250K to 2525K until a constant vaporizing, non-stoichiometric composition approaching $UC_{1.1}$ was formed. Rates of evaporation of this composition, measured from 2190K to 2525K by the Langmuir method, are described by

$$\log_{10} m(UC_{1.1(s)}) = 9.148 - 3.574 \times 10^4 T^{-1} (g\text{-}cm^{-2}\text{-}sec^{-1}).$$

Based on the decomposition process

$$UC_{1.1(s)} \rightarrow U_{(g)} + n_1C_{1(g)} + n_2C_{2(g)} + n_3C_{3(g)}$$

the partial pressure of uranium is given by

$$\log_{10} PU_{(g)} (atm) = 8.191 - 3.624 \times 10^4 T^{-1}$$

The rate of evaporation and consequently the vapor pressure of carbon was found to be equivalent to that over graphite. A third law analysis yields a heat of vaporization at 298K of 235.1 ±2.7 kcal/mole for the above vaporization process. The resultant standard heat of formation of $UC_{1.1(s)}$ at 298K is −21.2 ±4.1 kcal/mole if 125 ±3 kcal/mole is taken as the heat of sublimation of uranium. Author

N66-12324 Unified Science Associates, Inc., Pasadena, Calif.
NEW ASPECTS OF THE FORMATION OF MONODISPERSED SULFUR HYDROSOLS
Olgierd J. Klejnot and Sam Naiditch *In its* Study of Ionization Potential of Small Particles Oct. 1965 17 p refs (See N66-12320 03-23)

The reaction of sodium thiosulfate and acid at concentrations of 10^{-3} M each (1:1) occurs in several stages. After a sequence of homogeneous reactions during an induction period a dilute polydispersed sulfur hydrosol is formed, accompanied by evolution of hydrogen sulfide. After six hours, the higher-order Tyndall spectrum (HOTS) is seen, increases for 18 hours, then decreases for three days while the increasingly more polydispersed sol settles out. In 10^{-2} M solutions containing 0.2 vol-% of acetone, grossly polydispersed sulfur settles out copiously, then HOTS appear. Dilution of a 0.9035-molar solution of 0.001 M at an early stage also leads to the appearance of HOTS. The discussion covers the effects of dilution, effects of adding acetone, acidity defect by H_2S evolution, presence of several varieties of sulfur, importance of chain-breaking reactions and a model of particle growth which is based on the new observations. The new model postulates that with decreasing particle size, their solubility increases, reaches a maximum and decreases again. Author

N66-12337 Research Triangle Inst., Durham, N. C. Solid State Labs.
DIFFUSION OF SILICON FROM A GASEOUS SOURCE. II: DIBORANE
A. M. Smith and R. P. Donovan *In its* Design Parameters and Procedures for Functional Electron. Struct. Sep. 1965 p 118–137 refs Presented at the Electrochem. Soc. Meeting, Toronto, 4 May 1964 (See N66-12334 03-09)
(Contract AF 33(657)-10340)

Diborane gas can be used as the source for the p-type impurity diffusion of silicon. A sufficient oxygen supply is required to prevent deposition of elementary boron on the diffusion tube walls, and surface damage to the silicon must be prevented during diffusion. By controlling the flow rate of the diborane, it is possible to control surface concentration, junction depth, and sheet-resistivity of boron-diffused silicon. The limiting solid solubility of boron can be obtained without forming a hard to remove boron-rich phase on the surface of the silicon; when the flow rate of diborane is greater than this, the boron-rich phase results. At high surface concentrations of 10^{21} cm^{-3}, reproducibility of diffusions is excellent; at 10^{18} cm^{-3} it is good. A diborane gas system is shown to have all the capabilities of conventional systems employing solid boron oxide or liquid boron tribomede, but it has the advantages of cleanliness, ease of installation and operation, uniformity of source composition, and insensitivity to water vapor and temperature. M.W.R.

N66-12338 Research Triangle Inst., Durham, N. C. Solid State Labs.
DIRECT DYNAMIC OBSERVATIONS OF IMPURITY FLOW PATTERNS DURING GAS-SOURCE BORON DIFFUSIONS OF SILICON
A. M. Smith and R. P. Donovan *In its* Design Parameters and Procedures for Functional Electron. Struct. Sep. 1965 p 139–163 refs Presented at the Electrochem. Soc. Meeting, Washington, Oct. 1964 (See N66-12334 03-09)

The effect of flow patterns generated by natural convection is found to be negligible for diborane gas-in-silicon diffusions performed at solid solubility surface concentrations. When diffusions are performed at low surface concentrations these flow patterns appear to cause large variations in the silicon diffusion parameters as a function of the transverse position of a wafer on the diffusion boat. The diffusion apparatus is discussed and illustrated, and photographs of the flow conditions are included. A flow pattern occurring during typical diffusion is shown as are flow streamlines in planes normal to the tube axis. M.W.R.

N66-12339 Research Triangle Inst., Durham, N. C. Solid State Labs.
IMPURITY DIFFUSION IN SILICON
A. M. Smith and R. P. Donovan *In its* Design Parameters and Procedures for Functional Electron. Struct. Sep. 1965 p 165–181 refs Presented at 3d Ann. Microelectron. Symp., St. Louis, Apr. 1964 (See N66-12334 03-09)

Theoretical and practical aspects of impurity diffusion in silicon are discussed. Fick's second law is solved for a number of boundary conditions; the solutions obtained are compared with the measured data and shown to be valid only under certain experimental conditions. The experimentally determined values of the diffusion coefficients of 28 impurities in silicon are listed. Concentration, both of background impurity and diffusion impurity, can influence the value of the diffusion coefficient. This influence is illustrated by data from boron and phosphorus diffusions. Some typical, practical diffusion systems are described, emphasizing the techniques of open tube diffusion of boron and phosphorus. The capabilities and limitations of diffusion processes are discussed. The conclusion reached is that available techniques allow the requirements of present integrated silicon devices to be met. However, increased capabilities for the diffusion processes are both possible and desirable. Such improvements will allow improved performance of present devices and realization of devices not now practical. Author

N66-12340 Research Triangle Inst., Durham, N. C. Solid State Labs.
FORMATION AND PROPERTIES OF OXIDES ON SILICON
R. P. Donovan *In its* Design Parameters and Procedures for Functional Electron. Struct. Sep. 1965 p 183–205 refs Presented at the 4th Ann. Microelectron. Symp., St. Louis, May 1965 (See N66-12334 03-09)

Kinetics for methods of growing oxide layers on silicon are discussed and results with typical experimental systems are presented. High temperature reactions of silicon with steam, dry oxygen, and wet oxygen; as well as anodic reaction of silicon with various electrolytes or plasmas are considered. Pyrolytic decomposition, reactive sputtering, or vacuum evaporation may also be used for oxide formation. While this latter group does not require the silicon from the underlying wafer to participate in the formation, control over interface properties is more difficult than when oxides are grown. Effect of impurities on bulk physical and electrical properties of commercial glass is discussed because it is assumed that the oxide layer is primarily glassy silicon whose impurity concentration and composition vary with the method of formation. Several models, none of which is adequate by itself, are used to explain the surface inversion phenomenon whereby the electrons at the silicon surface seem to increase in number following thermal oxidation. M.W.R.

N66-12377# Naval Research Lab., Washington, D. C.
HIGH-TEMPERATURE PROPERTIES OF POTASSIUM
C. T. Ewing, J. P. Stone, J. R. Spann, E. W. Steinkuller, D. D. Williams et al 24 Sep. 1965 85 p refs
(NRL-6233; AD-622190) CFSTI: $3.00

A reporting of the experimental results for potassium (saturation and superheat properties of the vapor, density and specific heat of the liquid) is presented together with a thermodynamic treatment of the data. Two equations of state are advanced, one virial and one quasi-chemical; and additional saturation and superheat properties of the vapor are derived from these equations. Either of two paths can be used in deriving absolute thermodynamic properties, the monomeric gas path or the liquid path; but results obtained by the former procedure are believed to be more accurate. Enthalpy, entropy, specific volume, specific heat, and compositional information (weight fraction of dimer, weight fraction of tetramer, and average molecular weight) are tabulated for some 800 selected vapor states in the temperature range from 1400 to 2525 F and in the pressure range from 0.2 to 35 atm. Author (TAB)

N66-12379# Martin Co., Baltimore, Md.
THEORETICAL AND QUANTUM CHEMISTRY OF N, O, F COMPOUNDS Quarterly Technical Report, 9 Jul.–9 Oct. 1965
Joyce J. Kaufman [1965] 8 p refs
(Contract DA-31-124-ARO-D-203; ARPA Order 542)
(QTR-6; AD-471817)

The objective of the research was to investigate the theoretical and quantum chemistry of energetic N. O. F. compounds with the aim of providing understanding of the fundamental bonding and behavior of these species. Author (TAB)

N66-12392# Aerojet-General Corp., Azusa, Calif. Chemical Products Div.
STUDY OF THE REACTION OF PENTABORANE WITH HYDRAZINE AND SUBSTITUTED HYDRAZINES Final Report, 1 Mar. 1962–28 Feb. 1965
H. V. Seklemian, R. W. Lawrence, and G. A. Guter Apr. 1965 47 p refs *Its* Rept.-2015
(Contract AF 49(638)-1122)
(AFOSR-65-1058; AD-619513)

Pentaborane and hydrazine were found to react in solution according to the following equation: $B_5H_9+2N_2H_4$ yields $B_5N_4H_{16}+0.5H_2$. The process includes an initial fast reaction followed by a slow reaction that evolves hydrogen and an insoluble solid product. The hydrogen evolution was found to be a first-order process with a rate constant of $1.74 \pm 0.1 \times 0.0001$/sec at 25C. The rate determining step was found to be dependent only on the hydrazine concentration. When monomethylhydrazine (MMH) and unsymmetrical dimethylhydrazine were used in place of normal hydrazine, the respective reactions were as follows: $B_5H_9+4CH_3NHNH_2$ yields $B_5N_8H_{20}$ $(CH_3)_4+0.5H_2$, and $B_5H_9+2H_2NN$ $(CH_3)_2$ yields $B_5N_4H_{13}$ $(CH_3)_4$. The hydrogen from the reaction involving MMH also evolved by a first-order process, and the postulated mechanism is the same. The products of the pentaborane–hydrazine and pentaborane–MMH reactions are insoluble in nonpolar solvents. They thermally decompose, evolving hydrogen. It is believed that the products are polymeric substances. Attempts to obtain a definitive structure for the insoluble products by nuclear-magnetic resonance techniques and high-resolution infrared analysis were unsuccessful. Author (TAB)

N66-12464# Bureau of Mines, College Park, Md.
METHODS FOR PRODUCING ALUMINA FROM CLAY. AN EVALUATION OF TWO AMMONIUM ALUM PROCESSES
Frank A. Peters, Paul W. Johnson, and Ralph C. Kirby 1965 54 p refs
(BM-RI-6573)

A series of economic evaluations of processes for producing metallurgical-grade alumina from low-grade aluminous materials is being conducted by the Bureau of Mines to determine the relative processing costs. The two processes considered in this evaluation are concerned with the recovery of alumina from clay through the formation of ammonium alum. In the first process, dehydrated clay is leached with ammonium bisulfate solution; in the second process, clay is baked with ammonium sulfate and then leached with water containing a small quantity of sulfuric acid. After the alumina is dissolved by either of these methods, the iron is reduced to the ferrous state to avoid crystallization of ferric sulfate with the alum. The recovery of pure alum requires two crystallization steps. The alum crystals are then redissolved and precipitated with ammonia to produce alumina hydrate, which is calcined to α-alumina. Author

N66-12530*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPLORATORY STUDY OF A NEW CLASS OF STEP-LADDER AND LADDER POLYMERS—POLYIMIDAZOPYRROLONES
George F. Pezdirtz and Vernon L. Bell Washington, NASA, Dec. 1965 21 p refs
(NASA-TN-D-3148) CFSTI: HC $1.00/MF $0.50 CSCL 07C

A new class of aromatic-heterocyclic polymers has been discovered. These were prepared from the room-temperature reaction of tetraamines with tetraacids or their respective derivatives. This new class of polymers is polyimidazopyrrolones or "Pyrrones." Exploratory experiments indicate that they have excellent thermal and radiolytic stability and hold considerable potential for aerospace as well as highly specialized terrestrial applications. The chemical structure of the Pyrrones combines the structures of the aromatic polyimides and polybenzimidazoles. Since they are formed through an intermediate stage which is soluble, typical solution property measurements can be used for basic molecular characterization. Knowledge of the molecular properties of the soluble intermediate reflect on the molecular character of the final insoluble Pyrrones. A reaction scheme for the conversion of the soluble intermediate is presented. Applied properties such as ease of fabrication, mechanical strength, and molding characteristics are discussed. Author

N66-12573# Joint Publications Research Service, Washington, D. C.
INTERACTION OF CHLORAL HYDRATE AND HYDROXYLAMINE WITH SOME SUBSTITUTED ANILINES
A. S. Petrov, I. N. Somin, and S. G. Kuznetsov 9 Nov. 1965 7 p refs Transl. into ENGLISH from Zh. Organ. Khim. (Moscow), v. 1, no. 8, 1965 p 1434–1437
(JPRS-32784; TT-65-33362) CFSTI: $1.00

The interaction of chloral hydrate and hydroxylamine with substituted anilines and beta-aminopyridine used to synthesize isonitrosoacetanilides containing various dimethylamino and dimethylaminomethyl groups at the benzene ring, and the beta-pyridylamide of isonitrosoacetic acid. A new mode of synthesis is proposed for aromatic amides of isonitrosoacetic acid, which is based on the acid chloride of chloro-ethoxyacetic acid, by means of which it was possible to obtain o-dimethylaminoanilide which is not obtained by the reaction of chloral hydrate and hydroxylamine. R.N.A.

N66-12618# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE APPLICATION OF GAS CHROMATOGRAPHY IN RESEARCH OF SURFACE CHEMISTRY AND CATALYTIC REACTIONS
Chang Sue and Lau Nan Chuan 18 Aug. 1965 45 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 8, 1963 p 28–44
(FTD-TT-65-331/1+2+3+4; AD-620817)

The determination of adsorption isotherms, surface area, adsorption heat, and the application of chromatography to the study of catalysis are discussed and the mechanisms of catalytic chromatography are examined. Emphasis is given to the problem of catalytic reactions through the observation of the chromatographic outflow graph when the chromatographic column and the bed-layer of the catalytic reaction are identical. Under such circumstances, the flowing reactants come into contact with the catalytic bed-layer where the reaction products are formed. It was found that the adsorption of one or more reactants is an indispensable step in this type of reaction. The solution of the function of the chromatographic outflow curve is given for the adsorption and desorption kinetics of hydrogen on iron catalysts. Also, adsorption isobars of hydrogen on nickel-silica gel are shown. E.E.B.

N66-12620# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POLYMERS WITH CONJUGATION SYSTEM. PART 50: SYNTHESIS AND INVESTIGATION OF ELECTROPHYSICAL PROPERTIES OF PHTHALOCYANINE POLYMERS (POLYMERIC PHTHALOCYANINES)
A. A. Berlin and L. G. Cherkashina et al 18 Jun. 1965 12 p refs Transl. into ENGLISH from Vysokomol. Soedineniya (USSR), v. 6, no. 5, 1964 p 832–837
(FTD-TT-65-303/1+2+4; AD-620999)

The report is devoted to the synthesis and study of polymeric phthalocyanines formed as the result of the polycoordination of 1, 2, 4, 5-tetracyanobenzene and its mixtures with phthalonitrile by interaction with powdered copper or its monochloride (Cu_2Cl_2). The synthesis was carried out with the objective of elucidating the effect of the oxygen-containing groups and the branching of the molecular structure on the electrophysical properties of the polymers. It was shown that polymers synthesized from tetracyanobenzene possess an electroconductivity at 300K of 0.00001-100/ohm/cm at E = 6 kcal/mole as compared with the polyphthalocyanines from pyromelitic acid with a conductivity of 0.0001/ohm at E = 4.2 kcal/mole. The electroconductivity of tetracyanobenzenephthalonitrile copolymers treated with H_2SO_4, accompanied by hydrolysis of the nitrile groups, is 0.00001 and $10^{-2.6}$/ohm/cm for reprecipitated and non-reprecipitated specimens, respectively. A study of the thermostability of the synthesized polyphthalocyanines showed that specimens of the polymer which during treatment underwent hydrolysis of the nitrile groups, break down in air as a rule at higher temperature than the nitrile-containing analogs. Author (TAB)

N66-12676# Atomic Energy Commission, Washington, D. C.
BIOASSAY AND ANALYTICAL CHEMISTRY MEETING
[1964] 224 p refs Proc. of the 10th Ann. Meeting Held at Cincinnati, 8–9 Oct. 1964 Sponsored by Natl. Lead Co. of Ohio
(CONF-727) CFSTI: $2.50

Bioassay and analytical chemical procedures and associated applications are presented. For individual titles see N66-12677–N66-12697.

N66-12677 National Lead Co. of Ohio, Cincinnati.
RECENT BIOASSAY ACTIVITIES AT NATIONAL LEAD COMPANY OF OHIO
Michael W. Boback and Richard C. Heatherton *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 4–19 refs (See N66-12676 03-06) CFSTI: $2.50

Some recent nonroutine problems (bio-assay activities) are summarized covering investigations on: (1) fusion of NaF, fluorometric determination of uranium; (2) uranium in lung and lymph node tissues; (3) passivity of uranium slivers in hand injuries; (4) radium from remelt operations; (5) plant radiation levels; (6) uranium in fecal samples; and (7) radionuclides in waste streams. R.W.H.

N66-12678 Argonne National Lab., Ill.
REPORT OF BIOASSAY ACTIVITIES AT ARGONNE NATIONAL LABORATORY
William D. Fairman *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 20 (See N66-12676 03-06) CFSTI: $2.50

A review of recently completed analytical and instrumental techniques is presented. Among the items mentioned are: (1) the determination of iodine-131 in milk and urine by initial exchange of the inorganic iodide onto silver chloride, followed by solvent extraction and coprecipitation with silver iodide; (2) the determination of promethium-147 in urine by extraction into 2-diethylhexyl phosphoric acid-benzene, followed by liquid scintillation counting of the organic extract; (3) sequential determination of uranium, neptunium, and plutonium in urine by use of triisooctylamine-xylene extractions, anion exchange, and electrodeposition; (4) determination of uranium in urine by extraction into 2-diethylhexyl phosphoric acid-benzene prior to anion exchange and electrodepsotition; (5) a least squares Fortran program for the determination of components of radioactive decay mixtures by computer analysis of count-rate data; and (6) applications of multiparameter analysis to bioassay. R.W.H.

N66-12679 Hanford Atomic Products Operation, Richland, Wash.
A PROGRESS REPORT ON RADIOLOGICAL CHEMISTRY AT HANFORD
J. M. Nielsen *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 21–24 refs (See N66-12676 03-06) CFSTI: $2.50 (Contract AT(45-1)-1350)

Two large area alpha spectrometers were constructed. The larger chamber is a gridless concentric cylindrical ionization chamber in which the 15000 cm^2 aluminum coated plastic sheet contains the source and forms the outer electrode. The smaller chamber is similar to the larger chamber but has an effective source area of about 1200 cm^2. Backgrounds equivalent to a contamination of less than 0.05 dpm per nuclide are obtained with this instrument. In Cs^{137} studies, the analysis of hair is of interest as a possible means of estimating radioisotope concentrations in the body. Hair samples ranging in weight from 1 to 15 g were obtained from adult male and female Eskimos. Each of 20 hair samples measured showed detectable amounts of Cs^{137}. When compared to the Cs^{137} body burdens, male hair samples gave concentrations ranging from 3 to 8 dpm/g of hair/μc Cs^{137} in the body while values for the female hair samples showed less consistency and ranges of 1 to 20 dmp/g of hair/μc Cs^{137} in the body. R.W.H.

N66-12680 Mound Lab., Miamisburg, Ohio.
POLONIUM URINALYSIS PROCEDURE
W. E. Sheehan *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 25–31 refs (See N66-12676 03-06) CFSTI: $2.50 (Contract AT(33-1)-GEN-53)

The urinalysis procedure for the determination of polonium, which had been used for 16 years, was revised. Although the efficiency of each procedure was the same, the count level of the modified procedure was four times greater. Author

N66-12687 Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant.
DETERMINATION OF PROMETHIUM-147 IN ENVIRONMENTAL SAMPLES
R. W. Taylor *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 102–109 refs (See N66-12676 03-06) CFSTI: $2.50

A procedure employing a combination of simple analytical techniques was developed to determine Pm^{147} in environmental samples. Lanthanides were initially precipitated from solution as hydroxides. Rare earths that interfere with beta counting of Pm^{147} and other contaminants were removed by ion exchange, solvent extraction, and precipitation. Pm^{147} was finally co-precipitated with neodymium oxalate, fired to the oxide, and counted in a gas-flow proportional counter. Recovery was 71% $\pm$9% (relative standard deviation). Decontamination factors for fission products usually found in environmental samples were > 10,000. Author

N66-12690 Argonne National Lab., Ill.
MEASUREMENT OF RADIUM-226 AND RADON-222 IN ENVIRONMENTAL SAMPLES
Naomi A. Harley, John H. Harley, and Isabel M. Fisenne *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 142–151 (See N66-12676 03-06) CFSTI: $2.50

The Ra^{226} levels that were present in the environment were documented accurately. Radium-226 is easily determined by the classical technique of emanating and counting its gaseous daughter radon-222. It was noted that radium was separated from the bulk matrix by a simple $ReBaSO_4$ precipitation. The final $Ra^{226}BaSO_4$ precipitate was then dissolved in alkaline EDTA for emanation. The volume of this emanation solution was about 20 ml. After gamma counting for radiochemical yield the solution was placed in a radon emanation flask which has a total capacity of about 40 ml. Duplicate emanations are performed on each sample to give an estimate of the error involved in the measurement. R.W.H.

N66-12691 California Univ., Berkeley. Lawrence Radiation Lab.
RECOVERY OF Am^{241} IN THE PRESENCE OF DTPA
Anne De G. Low-Beer and Howard G. Parker *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 152–154 (See N66-12676 03-06) CFSTI: $2.50

The recovery of Am^{241} in the presence of DTPA by the alkaline phosphate precipitation method was investigated. Results were compared with the wet ashing method, for spikes processed in aqueous solution, for human urine spiked in vitro, and for urine of rats injected with Am^{241} and DTPA. From the results shown it appears that in water or urine, recovery of Am^{241} from the alkaline phosphate precipitate was only slightly less than for the wet ash method. In the presence of DTPA, recovery in the precipitate was approximately 10%. It was concluded that at pH 8 Am^{241} was strongly chelated, and accordingly the alkaline phosphate precipitation method was not suitable for the quantitation of urinary alpha activity in patients who were treated with DTPA. R.W.H.

N66-12692 Argonne National Lab., Ill.
THE USE OF COULOMETRY IN ROUTINE ANALYSIS
Thomas L. Duffy and Byron L. Ferguson *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 155–160 refs (See N66-12676 03-06) CFSTI: $2.50

Some of the applications made in developing new procedures for two general types of problems are reported: standard solutions where the interferences are low, and air samples collected for exposure evaluation. In coulometry a current is passed through the solution causing a desired electrochemical process to occur. In some cases it is necessary to control the potential of the generating electrodes so that only one reaction occurs. This is referred to as controlled potential coulometry. In others the current is controlled and the total number of coulombs consumed can be found by timing the constant current. This has been called constant current coulometry and coulometric titration. It is essential that all of the current be used in the desired reaction. R.W.H.

N66-12693 Rocky Flats Div., Dow Chemical Co., Golden, Colo.
A SIMPLE ANALYTICAL METHOD FOR ISOLATING LOW LEVEL ALPHA ACTIVITY OF AMERICIUM-241 FROM PLUTONIUM IN A ROUTINE URINALYSIS PROCEDURE
D. L. Bokowski *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 161–170 refs (See N66-12676 03-06) CFSTI: $2.50

A method is described for the analysis of Am^{241} in human urine. Plutonium is extracted by thenoyltrifluoroacetone in a routine urinalysis procedure. Americium is isolated from the residue of this procedure. The method involves addition of sufficient sodium hydroxide to redissolve aluminum hydroxide while coprecipitating americium on lanthanum hydroxide. Trivalent americium is oxidized to the sexivalent americyl ion by silver catalyzed peroxy-disulfate. Addition of ammonium fluoride stabilizes the americyl ion while precipitating lanthanum and accompanying alpha-emitting impurities as fluorides. Following manganous nitrate reduction to the trivalent state, the purified americium is recovered from the supernatant by coprecipitation with radiopure cerium. The cerium fluoride is counted in a low background proportional alpha counter. The method is effective for quantitative separation of americium from the lanthanides, other actinides, iron and aluminum. Sensitivity is sufficient to detect activities as low as 0.50 dpm. Author

N66-12695 Atomic Energy Commission, Washington, D. C.
THE SIMULTANEOUS DETERMINATION OF CALCIUM, STRONTIUM, AND BARIUM IN BONE ASH BY RADIOCHROMATOGRAPHY
George A. Welford, Robert S. Morse, and Elias L. Chiotis *In its* Bioassay and Anal. Chem.. Meeting [1964] p 174–178 (See N66-12676 03-06) CFSTI: $2.50

A paper chromatographic method where only micrograms of a sample were used for direct analysis was investigated. The measurement of a bone sample for strontium has a sensitivity as low as that attained by a neutron generator having a flux of 10^{12} neutrons per square centimeter. The detection limits for barium and calcium were much lower. Strontium, barium, and calcium were separated and microgram quantities of bone were separated on a paper chromatogram by organic solvents. After separation, these elements were precipitated and tagged by a precipitant that was migrated along a chromatogram. The solvent moved the precipitant to the end of the chromatogram in order that the activity of the precipitant would not interfere with the analysis of the element. R.W.H.

N66-12697 Hanford Atomic Products Operation, Richland, Wash.
APPLICATION OF TERTIARY AMINE EXTRACTION TO THE DETERMINATION OF URANIUM IN BIOLOGICAL MATERIALS
T. M. Beasley *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 201–219 refs (See N66-12676 03-06) CFSTI: $2.50 (Contract AT(45-1)-1350)

The adaptation of tertiary amine extraction to the determination of uranium in tissue and urine is discussed. Procedures for the sequential analysis of the radioelements present are required to determine the solubility of the uranium ore dust in the lung and the resultant deposition of uranium and its daughter products in the various organs of the body. The analysis of the biological material for uranium and thorium are of particular interest. In addition, the radiochemical procedures developed are suitable for the analysis of urinary encreta from personnel involved in the processing of irradiated thorium, or individuals engaged in the investigation of U^{232} as a possible power source. R.W.H.

N66-12755 Joint Publications Research Service, Washington, D. C.
STUDIES ON ORGANOPHOSPHORUS COMPOUNDS. III: DIALKYL N,N-DISUBSTITUTED AMINOMETHYL PHOSPHONATE AND THEIR DERIVATIVES
Hsi-Chi Chiang *In its* Transl. on Communist China's Sci. and Technol., No. 244 23 Nov. 1965 p 32–44 refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peking), v. 30, no. 6, Dec. 1964 p 526–532 (See N66-12751 03-34) CFSTI: $3.00

The infrared spectra of N,N-disubstituted aminomethylphosphonates and their derivatives were investigated. These were found to have a broad N-N absorption band in the 2500 cm^{-1} region, and show two peaks at 1210 to 1230 cm^{-1} and 1060 to 1090 cm^{-1}, which are assigned to the POO^- asymmetric vibration and the POO^- symmetry vibration, respectively. In the case of sodium salts of these monoesters, the absorption bands at 2500 cm^{-1} disappear, but the POO^- asymmetric and symmetric absorptions at 1200 to 1225 cm^{-1} and 1060 to 1080 cm^{-1} still continue to persist. These results indicate that the monoalkyl N,N-disubstituted aminomethyl phosphonates exist in the form of a zwitter ion. Dialkyl and monoalkyl N,N-disubstituted aminomethyl phosphonates can be separated by paper chromatography and paper electrophoresis. The relationship between R, R' groups and R_f, R_g values is also discussed. C.T.C.

N66-12782# Imperial Coll. of Science and Technology, London (England). Dept. of Chemistry.
PHOTOCHEMICAL REACTIONS IN THE ALKALI HALIDES
Status Report No. 3, 1 Apr.–30 Jun. 1965
P. M. W. Jacobs [1965] 5 p
(Contract N62558-3549)
(AD-620443)

KCl was doped with DS^- ions by growing the crystal under deuterium in a sealed quartz vessel which also contains some sulphur. The equilibrium, $2D_2 + S_2$ reversibly yields $2D_2S$, then favours the reaction of D_2S with molten KCl. The kinetics of photolysis of the HS^- and DS^- ions were studied and also the kinetics of bleaching of the Hi (0) and Di (0) bands (Hi (0) = interstitial hydrogen atom). Author (TAB)

N66-12804# Columbia Univ., New York. Columbia Radiation Lab.
THE MICROWAVE SPECTRUM OF METHYL VINYL ETHER

Patrick Cahill, L. Peter Gold, and Noel L. Owen (Harvard Univ.) [1965] 14 p Prepared jointly with Harvard Univ.
(Contracts Nonr-266(45); DA-28-043-AMC-00099(E); Grant AT-ATOSR-330-63)
(AD-619912)

Many of the lines in the microwave spectrum of methyl vinyl ether were assigned to a planar cis molecular conformation, having the following principal moments of inertia, Ia ±27.7382, Ib ±79.1268, and Ic ±103.678 gm sq. cm^2. The dipole moment of the cis structure was measured and found to be 0.98 ±0.02 D (μa ±0.30 D and μb ±0.93 D). Vibrationally excited states of this species were assigned using a microwave double-resonance technique. This method consists of observing the change in one transition while a second transition is saturated with microwave power. Changes occur only if the two transitions have a common energy level. Various evidence indicates an unusually large value for the barrier to internal rotation of the CH_3 group. Author (TAB)

N66-12839# Airtron, Inc., Morris Plains, N. J.
HYDROTHERMAL GROWTH OF CRYSTALS OF $LaAlO_3$ Semi-annual Technical Summary Report, 31 Dec. 1964–1 Jul. 1965
[1965] 43 p refs
(Contract Nonr-4615(00); ARPA Order 306-62; Proj. Defender)
(R11-488; AD-621708)

Large crystals of $LaAlO_3$ were successfully grown from a straight PbF_2 flux. However, soak temperatures above 1400° C are required for solution of LaF_3 formed by the reaction of La_2O_3 and PbF_2. These high temperatures result in premature failure of the furnace and platinum container. PbF_2 was, therfore, abandoned and a search was initiated to modify the PrF_2 flux, or to find a more suitable solvent. Among the solvents investigated were PbO–PbF_2, BaO and Bi_2O_3, all with small additions of B_2O_3. Results are encouraging. The regions of phase stability were determined for $LaAlO_3$ and La $(OH)_3$ under hydrothermal conditions. From this data it is apparent that in order to operate in a region where $LaAlO_3$ is the only stable solid and to stay below the 435° C transition temperature, the solvent concentrations must be < 2 or < 7 m K_2CO_3. The composition of the fluid was analyzed quantitatively for alumina and lanthana content. Although the data show considerable scatter, they are in agreement with and have confirmed the observed crystallization of solid $La(OH)_3$. In the large crystal growth autoclaves, spontaneous nucleation of $LaAlO_3$ in the growth chamber has been obtained from a nutrient composed of powdered La_2O_3 and flame fusion ruby pieces.
Author (TAB)

N66-12872*# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
CARBON DIOXIDE DISSOCIATION RATES BEHIND SHOCK WAVES Final Report, Mar. 1963–Mar. 1964
Sep. 1964 33 p refs
(Contract NAS7-217)
(NASA-CR-68229; TR64-49) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The dissociation rates of carbon dioxide have been measured at elevated temperatures behind shock waves in mixtures with argon and nitrogen. The disappearance of carbon dioxide was monitored by following the emission in the 4.3μ and 2.7μ infrared bands. Over the range from 3,300 to 6,000° K at total pressures of 0.5 to 1.0 atm, the bimolecular rate constant for the process

$$CO_2 + M \rightarrow CO + O + M$$

in mixtures of 0.5 to 2.0 percent carbon dioxide in argon is given by

$$k_A = 2.26 \times 10^{11} T^{1/2} e^{-71,900/RT} mole^{-1} cm^3 sec^{-1}.$$

For dilute mixtures of 1.0 percent carbon dioxide in nitrogen from 3,100 to 7,700° K the corresponding rate constant is

$$k_{N_2} = 1.18 \times 10^{11} T^{1/2} e^{-73,200/RT} mole^{-1} cm^3 sec^{-1}.$$

The rate constant in nitrogen mixtures was independent of the total pressure from 0.5 to 5.0 atm for a series of tests at about 4,800° K. Variations of mixture ratios of up to 20 percent carbon dioxide in nitrogen yielded results within the experimental spread for the dilute mixtures. Possible mechanisms for the dissociation are discussed in the report. Author

N66-12915# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
ISOTOPE EFFECTS IN ELIMINATION REACTIONS Final Report
Louis J. Steffa, Lipot Pentz, and Edward R. Thornton Jun. 1965 17 p refs
(Contract AT(30-1)-3041)
(NYO-3041-1)

The bimolecular elimination reaction E2 of various β-phenyl compounds was studied at 80.5° using DO^- in D_2O and HO^- in H_2O as attacking bases. The secondary isotope effects were found to be quite high (k_D/k_H = 1.8 to 1.57), indicating a high degree of proton transfer and carbanion character in the transition states. After a review of solvent isotope effects, a study was made of acid equilibria in H_2O–D_2O mixtures. The self-ionization constant of D_2O was determined to be $K_{D_2O} = 1.379 \times 10^{-15}$. Acidic and basic dissociation constants in H_2O–D_2O mixtures were measured for 2,4-dinitrophenol, 2-nitrophenol, and imidazole. Values of K'_n (relative basicity of DO^- and HO^-) were calculated from dissociation constants of several organic acids; the best K'_n value is estimated to be 2.27, which gives an exchange constant L = 10.3 NSA

N66-12918# Sandia Corp., Albuquerque, N. Mex.
HIGH TEMPERATURE METALLIC OXIDATION REACTIONS. I: KINETICS AND MECHANISM
H. S. Levine Oct. 1965 23 p refs Sponsored by AEC
(SC-RR-65-513)

A theory of high-temperature metallic oxidation reactions is developed in terms of parabolic reaction processes, oxide dissolution and diffusion phenomena, gaseous boundary layer interactions, and self-heating phenomena. The parabolic reaction processes and the oxide dissolution and diffusion phenomena appear to be independent of and competitive with each other in establishing oxide film growth rate. The reaction rate is equivalent to the ionic current through the oxide film; it differs from the oxide film growth rate by the oxide dissolution flux. Equations of continuity govern the motion of the phase boundaries. Boundary conditions for the system vary with gas composition and reaction rate. Temperature changes occur in the reacting system as a result of energy released at the two oxide interfaces; these changes depend on reaction rate and local heat of reaction as well as on heat conduction and exchange processes. Author

N66-12920# Bureau of Mines, Berkeley, Calif. Thermodynamics Lab.
HEATS OF FORMATION OF ANHYDROUS FERRIC SULFATE AND INDIUM SULFATE
Ronald Barany and L. H. Adami 1965 12 p refs
(BM-RI-6687)

The heats of formation of anhydrous ferric sulfate and anhydrous indium sulfate were determined by solution calorimetry. At 298.15° K the heats of formation from the metal, rhombic sulfur, and oxygen were −615.6 ±0.7 kcal/mole for ferric sulfate and −649.6 ±0.6 kcal/mole for indium sulfate. Heats of decomposition at 298.15° K are given for the reaction that forms metal oxide, sulfur dioxide, and oxygen, and for the reaction that forms the metal oxide and sulfur trioxide. Author

N66-12937# Los Alamos Scientific Lab., N. Mex.
AN INERT ATMOSPHERE ENCLOSURE FOR THE PREPARATION OF SAMPLES PRIOR TO THE DETERMINATION OF OXYGEN
Maynard E. Smith, James M. Hansel, and Glenn R. Waterbury 27 Aug. 1965 9 p refs
(Contract W-7405-ENG-36)
(LA-3344)

An inert atmosphere enclosure was assembled by equipping a commercial glove box, constructed from acrylate and methacrylate resin, with a gas purifying and circulating system designed to remove water, oxygen, nitrogen, and carbon dioxide from the argon atmosphere. Linde Molecular Sieve 5A is used as the desiccant and carbon dioxide trap, and uranium turnings, heated to 640° C, serve as a getter. The water and oxygen concentrations are continually monitored, and an atmosphere containing less than 2 ppm of either constituent can be readily maintained while the box is in use; the concentrations decrease slowly when the box is not being used and the glove covers are in place. Nitrogen and carbon dioxide also are removed effectively by the purification system. Relative efficiencies of anhydrous magnesium perchlorate and molecular sieve as desiccants, and of heated copper and uranium turnings as getters, were investigated. A device is described that prevents atmospheric contamination of samples during transfer from the enclosure to an apparatus for determining oxygen. Author

N66-12987# Argonne National Lab., Ill.
ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 4: FLUIDIZED-PACKED BEDS: STUDIES OF HEAT TRANSFER, SOLIDS–GAS MIXING, AND ELUTRIATION
John D. Gabor and William J. Mecham Mar. 1965 130 p refs
(Contract W-31-109-ENG-38)
(ANL-6859) CFSTI: $4.00

A system involving the fluidization of small particles in the voids of a packed bed of larger particles has been referred to as a "fluidized-packed" bed. Because of the movement of the fluidized particles, improvement of transport properties for the fluidized-packed bed is attained in comparison to a packed bed. The fluidized-packed bed has found application in the development of a fluoride volatility process for the recovery of fissionable values from spent uranium dioxide reactor fuels. In this process, a highly exothermic fluorination is carried out. The uranium dioxide pellets are too large to be fluidized directly, but the addition of inert fluidized, alumia grain has improved heat and mass transfer from the reacting surfaces of the pellets. Various properties of fluidized-packed beds have been studied from a basic point of view; bed expansion and pressure drop, solids mixing, gas mixing, effective bed thermal conductivity, heat-transfer coefficients at the column wall and fixed packing surface, and elutriation. Data and theoretical discussions of mechanisms are presented. In addition, the empirical and theoretical results are applied to process design and, where possible, compared with pilot-plant data. Author

N66-13005# Picatinny Arsenal, Dover, N. J. Feltman Research Lab.
THE CATALYTIC ACTIVITY OF METALS IN CHEMILUMINESCENT REACTION BETWEEN LUMINOL AND HYDROGEN PEROXIDE
A. K. Babko and N. M. Lukovs'ka Sep. 1965 6 p Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), 1962 p 619–621
(PA-TM-1711; AD-469403)

A comparison was made of the catalytic action of a number of salts on the chemiluminescent reaction between luminol and hydrogen peroxide. An instrument consisting of a photomultiplier, amplifier and recorder was used for the investigation. Data on the change in intensity of luminescence with time and the values of the sums of luminescence for 160 sec are presented for: $K_3Fe(CN)_6$, $KMnO_4$, $CuSO_4$ and $CoCl_2$. It is shown that the first two substances bring about chemiluminescence without H_2O_2. For typical catalysts, such as cobalt and copper the great importance of the order of the components is discussed. Author (TAB)

N66-13036# Isotopes, Inc., Westwood, N. J.
HIGH ALTITUDE BALLOON SAMPLING PROGRAM, FIFTH QUALITY CONTROL Progress Report, Jan.–May 1965
Henry R. Girr and Colin G. Sanderson 31 Aug. 1965 22 p refs
(Contract AT(30-1)-3276)
(NYO-3276-10)

Data are presented from quality control studies of unexposed filter papers analyzed and processed during the period from Jan. to May 1965 for the same nuclides as were filter papers exposed during low-altitude aircraft sampling and high-altitude balloon sampling of the atmosphere for fallout. The blank samples were analyzed for ^{109}Cd, ^{113}Cd, ^{144}Ce, ^{137}Cs, ^{55}Fe, ^{54}Mn, ^{147}Pm, ^{238}Pu, ^{239}Pu, ^{125}Sb, and ^{90}Sr. Procedures used for the preparation of samples and the sequential separation of the isotopes are included. NSA

N66-13039# Junta de Energia Nuclear, Madrid (Spain). Seccion de Radioquimica.
PREPARATION OF HIGH SPECIFIC ACTIVITY OF ^{51}Cr BY THE SILARD-CHALMERS EFFECT ON POTASSIUM CHROMATE
M. Barrachina Gomez and M. A. Villar Castejon 1965 14 p refs
(JEN-144-DQ/1-45) CFSTI: HC $1.00/MF $0.50

A method was developed for preparing ^{51}Cr of at least 10-C/g for medical uses. After irradiation of potassium chromate in the JEN-1 Reactor, the chromate is dissolved in water and the ^{51}Cr is separated as chromium hydroxide. The irradiation time is about three weeks. NSA

N66-13040# Ludwig-Maximilians-Universitat, Munich (West Germany). Institut fuer Anorganische Chemie.
RESEARCH ON BINARY AND TERNARY OXIDES OF PROMETHIUM [UNTERSUCHUNGEN AN BINAREN UND TERNAREN OXIDEN DES PROMETHIUMS]
Volker Scherer 1965 43 p refs In GERMAN
(NP-15339) CFSTI: HC $1.00/MF $0.50

The existence of hexagonal and cubic lattice forms of Pm_2O_3 was established through radiation analyses of their pulverized particles. A-Pm_2O_3 was obtained as hydroxide from Pm^{147} and showed a violet-blue coloration; B-Pm_2O_3 was obtained by sintering of promethium oxalate-10-hydrate and possessed a violet-pink coloration; and C-Pm_2O_3

was extracted from a solution of Pm^{147} in HNO_3 and showed a coral-red coloration. Evaluation of the experimentally measured lattice constants established the ion radius of the Pm^{3+}-ions as calculated from the cell volumes of the oxide formations with 0.978 Å in comparison to predicted values of 0.979 Å. Transl. by G.G.

N66-13044# Oak Ridge National Lab., Tenn.
ACID LEACHING OF PRODUCTS FROM THE FLUIDIZED-BED COMBUSTION OF GRAPHITE-BASE REACTOR FUELS AND THE HF-O_2 DISINTEGRATION OF STAINLESS STEEL- AND ZIRCONIUM-CLAD OXIDE FUELS
L. M. Ferris Nov. 1965 32 p refs
(Contract W-7405-ENG-26)
(ORNL-2876) CFSTI: $2.00

This report is a summary of laboratory-scale leaching studies conducted with typical products from unirradiated fuel samples. Graphite-base fuels containing carbon-coated Th-U carbide or oxide fuel particles are easily burned in oxygen at 700 to 750° C in a fluidized bed of alumina. The product beds are dispersions of Th-U oxides in alumina. Leaching for 3 to 6 hr of typical product beds with boiling 4 to 13 *M* HNO_3 solutions that were also 0.05 *M* in HF resulted in thorium and uranium recoveries of 99.7% or higher. Less than 2% of the alumina (Norton RR) was dissolved. Reaction in a fluidized bed of alumina of stainless steel- or zirconium-clad UO_2 fuel with HF–O_2 mixtures at 600 to 650° C results in conversion of the claddings to their respective powdered oxides and the UO_2 to U_3O_8 powder. Author

N66-13052# Oak Ridge National Lab., Tenn. Isotopes Development Center.
THE USE OF ETHANOL IN ISOLATING ^{22}Na FROM CYCLOTRON TARGETS [PRIMENENIE ETANOLA PRI VYDELENII NATRIYA-22 IZ TSKLOTRONNYKH MISHENEI]
A. S. Zhukovskaya Jul. 1965 6 p refs Transl. into ENGLISH from Radiokhim. (USSR), v. 7, 1965 p 125–126
(ORNL-TR-625)

Sodium-22 is separated from a cyclotron target of magnesium metal by first leaching the sodium with ethyl alcohol from magnesium sulfate, followed by purification of the solution on an ion exchange column. The yield of ^{22}Na is 97%, the time necessary for the procedure is 6–8 hr starting with dissolution of the target. Author (NSA)

N66-13058# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.
THE ENERGY SPECTRUM OF π ELECTRONS IN LONG CHAINS OF CONJUGATED BONDS [ENERGETICHESKII SPEKTR π ELEKTRONOV V DLINNYKH TSEPYAKH SOPRYAZHENNYKH SVYAZEI]
Bai-Lin Khao, De-Shen Lyu, and Shi-Gan Chen Nov. 1965 23 p refs Transl. into ENGLISH from Scientia Sinica (Peiping), v. 10, no. 6, 1961 p 653–657
(TIL/T.5487) CFSTI: HC $1.00/MF $0.50

The LCAO–MO method is extended in this paper to include infinitely long periodic structures; a study is made of the electronic energy spectra of some ideal macromolecules possessing systems of conjugated bonds; attention is also given to the close ties existing between the spectrum and the structure and to the wide possibilities of chemical synthesis. Author

N66-13068# Kernforschungszentrum, Karlsruhe (West Germany). Laboratorium für Strahlenchemie.
SOLVATED ELECTRONS IN GAMMA-IRRADIATED FROZEN-IN SOLUTIONS [SOLVATISIERTE ELEKTRONEN IN γ-BESTRAHLTEN EINGEFRORENEN LOSUNGEN]
Klaus Eiben Dec. 1964 81 p refs In GERMAN
(KFK-293) CFSTI: HC $2.00/MF $0.50

The direct detection of the occurrence of hydrated electrons in the γ radiolysis of water and aqueous solutions was studied and the optical and paramagnetic properties of these reducing radical species were investigated. Alkali solutions frozen to 77° K were colored blue by γ irradiation. Simultaneously with the occurrence of the blue color, an ESR singlet signal was also detected. The place of the absorption maximum and the form of the ESR signals are dependent on the alkali hydroxide used. The concentration in paramagnetic centers and the color intensity per absorbed dose are directly proportional to the irradiation dose, but both are dependent upon the hydroxide concentration. The site of the absorption maximum is dependent on the solution medium in alkali solutions of heavy water and alcohols. It is displaced with respect to light water. At higher temperatures, both the light absorption and the ESR singlet decrease more from the melting point of the stabilizing matrix. The time pattern of this process corresponds to a pseudomonomolecular reaction. The addition of electron acceptors in high concentrations reduces the occurrence of the blue color in alkali ice. With the addition of electron acceptors at low concentrations, the blue coloration occurs in γ radiolysis. The simultaneous occurrence of a blue color and an ESR singlet signal was observed also in condensates of alkali metal vapors and water or alcohols at 77° K. From the experimental results, it was concluded that solvated electrons are formed in the γ radiolysis of frozen solutions. The hydrated electrons produced by radiation chemistry are chemically held in the solid solutions at low temperature in an arrangement of water molecules which does not vary from that postulated for liquid water by Platzman. NSA

N66-13070# Battelle-Northwest, Richland, Wash. Chemistry Dept.
SELECTIVE AND SENSITIVE ANALYSIS OF ACTIVATION PRODUCTS BY MULTIDIMENSIONAL GAMMA RAY SPECTROMETRY
W. Perkins and D. E. Robertson (Hanford Atomic Prod. Operation) 5 Apr. 1965 31 p refs
(Contract AT(45-1)-1350; AT(45-1)-1830)
(BNWL-SA-137; CONF-650405-5)

γ-ray spectrometry detector systems were developed for use with multidimensional analyzers which permit an extremely sensitive and selective analysis of complex radionuclide mixtures. With these systems, use is made of the individual γ-ray decay characteristic of each radionuclide for identification and measurement. This is accomplished by sandwiching the sample between two detectors and cancelling those events not totally absorbed in these detectors with a third annular detector which serves as an anticoincidence guard. The sample can be held in a fourth annular disc-shaped detector which allows the sample to be seen by the two principal detectors but which intercepts and cancels most of the degraded photons which would be scattered between them. The principal detectors are shielded from the γ-ray radiation originating in their phototubes with light pipes which provide a substantial background reduction. Applications of these instruments include the direct measurement of atomic-weapons produced radionuclide and cosmic-ray produced activation products in the atmosphere and the direct measurement of neutron activation products in water, soil, and biological materials.
Author (NSA)

N66-13071# Oak Ridge National Lab., Tenn.
STUDY BY THE EXTRACTION METHOD OF THE COMPLEXING OF AMERICIUM AND PROMETHIUM

I. Stary [1965] 10 p refs Transl. into ENGLISH from RUSSIAN
(ORNL-TR-759; JINR-R-2000)

The extraction constant of americium (K = −7.48) and promethium (K = 7.82) with thenoyltrifluoroacetone in benzene was determined. Also, the composition and stability constant of americium and promethium complexes were determined with tartaric acid ($\log \beta_1 = 3.9$; $\log \beta_2 = 6.8$), oxalic acid ($\log \beta_2 = 8.3$, $\log \beta_3 = 11.8$), nitrilotriacetic acid ($\log \beta_2 = 19.71$ for Am and 19.74 for Pm), ethylenediaminetetraacetic acid ($\log \beta_1 = 18.91$) and 1,2-diaminecyclohexaetetraacetic acid ($\log \beta_1 = 18.21$ for Am and 18.17 for Pm). It was shown that the complexes of americium are closer in stability to promethium complexes than to europium complexes. E.E.B.

N66-13081*# Melpar, Inc., Falls Church, Va.
THE CHEMISTRY OF COMETS An Annotated Bibliography
J. B. Evans and V. J. De Carlo Mar. 1965 61 p refs
(Contracts NASw-589; NASw-890)
(NASA-CR-68407) CFSTI: HC $3.00/MF $0.75 CSCL 07D

An annotated bibliography citing references for theoretical and experimental studies on the chemistry of comets is presented. The experimental studies referred to are designed primarily to derive an explanation of the chemical processes and mechanisms responsible for the formation of the emitting species observed from the spectra of comets. The theoretical studies refer to investigations initiated to describe the nucleus, coma, and tail in terms of structure, composition, temperature, evaporation, photodecomposition, and interaction with protons, electrons, and radiowaves. The references are divided into three areas: (1) those which report the results of land-based observations and the theoretical interpretations resulting from these observations, (2) those which report data obtained in the laboratory as a direct result of experimentation, and (3) those which report proposed plans for space investigations of comets. M.R.W.

N66-13082*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
CENTRAL POTENTIALS FOR POLYATOMIC MOLECULES. 1: A SURVEY OF MORSE POTENTIALS DETERMINED FROM VISCOSITY AND THE SECOND VIRIAL COEFFICIENT
Daniel D. Konowalow and Sergio Carrá 1 Jun. 1965 14 p refs
(Grant NsG-275-62; Contract AF 23(657)-7311)
(NASA-CR-68409; WIS-TCI-99) CFSTI: HC $1.00/MF $0.50 CSCL 07C

The Morse potential function is used to approximate the pair interaction potential for a wide variety of hydrocarbons. The effects of moleuclar asymmetry (narrowing and deepening of the potential well) are most clearly evident in potentials determined from experimental second virial coefficients. Such potentials are shown to be more realistic than those potentials determined from experimental viscosities which are much less sensitive to asymmetry. Author

N66-13084*# National Bureau of Standards, Boulder, Colo. Boulder Labs.
A COMPILATION OF THE PROPERTY DIFFERENCES OF ORTHO AND PARA HYDROGEN OR MIXTURES OF ORTHO AND PARA HYDROGEN
J. G. Hust and R. B. Stewart 20 May 1965 40 p refs
(NASA Order R-45)
(NASA-CR-68456; NBS-8812) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The experimental property differences of ortho and para hydrogen and their mixtures as reported in the world literature for temperatures below 300° K are tabulated. Properties included are specific heat, velocity of sound, thermal conductivity, density, viscosity, vapor pressure, saturated liquid and saturated vapor densities, and latent heat of vaporization. Pertinent comments regarding the experimental methods employed, the pressure and temperature range of the data, and the accuracy of the data are included when available. Author

N66-13094*# Stanford Univ., Calif. Instrumentation Research Lab.
AN INVESTIGATION OF THE MASS SPECTRA OF TWENTY-TWO FREE AMINO ACIDS
Nancy Martin 21 Sep. 1965 62 p
(Grants NsG-81-60; NB-04270; AF-AFOSR-886-65)
(NASA-CR-68432; IRL-1035) CFSTI: HC $3.00/MF $0.75 CSCL 07C

A mass spectrometer investigation was conducted on 22 free amino acids using a Bendix time-of-flight mass spectrometer. Existing fractionation and identification techniques for amino acids and previous mass spectrometer investigations of amino acids are discussed. The materials used are described along with the mass spectrometer, experimental conditions, thermal reactions of the free amino acids in vacuo, and the differential temperature analysis. The fragmentation patterns of the free amino acids in the mass spectrometer are presented. A scheme is proposed for identifying members of a mixture of free amino acids. From the work it seems certain that single free amino acids may be identified by their characteristic mass spectra. Although a number of experiments were repeated on particular amino acids, there were no multiple runs on all of them. Where repeat experiments were performed, the qualitative agreement was good. The milligram quantities of samples used were more than enough to obtain a spectrum for any of the compounds investigated. R.N.A.

N66-13101# Los Alamos Scientific Lab., N. Mex.
PREPARATION OF ULTRA-HIGH PURITY PLUTONIUM
J. A. Leary and L. J. Mullins 21 Jul. 1965 8 p refs
(Contract W-7405-ENG-36)
(LA-3356) CFSTI: $1.00

A method of eliminating essentially all of the detectable metallic impurities from electrorefined Pu is presented. The chemical analysis of the product metal is given in tabular form, and a brief discussion of the experiments and results is included. C.T.C.

N66-13106# Atomic Energy Commission, Washington, D. C. Div. of Biology and Medicine.
A STUDY OF LIQUIDS UNDER OPTICAL AND IONIZING EXCITATION WITH EMPHASIS ON EXCITATION IN THE VACUUM ULTRAVIOLET Final Report
I. Weinreb 1965 25 p refs
(NYO-2949-1)

Current oscillations in polystyrene are examined, and an investigation on energy transfer in liquids under excitation in the vacuum ultraviolet is briefly discussed. Emphasis is placed on determining if the current phenomenon is a bulk process. Consideration is given to bulk currents versus surface currents; field effects; and the influence of electrode materials, mechanical pressure, and alcohol vapor. C.T.C.

N66-13134# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
CATALOG OF NUCLEAR QUADRUPOLE INTERACTIONS AND RESONANCE FREQUENCIES IN SOLIDS. PART II: HALOGEN RESONANCES IN ORGANIC COMPOUNDS

S. L. Segel and R. G. Barnes Sep. 1965 110 p refs
(Contract W-7405-ENG-82)
(IS-1222) CFSTI: $4.00

Where available in literature, the halogen quadrupole resonance frequencies and the coupling constants in organic compounds are listed. The sources of the information are the more commonly available journals through August, 1965. Literature references to the original sources are given as well as references to articles immediately concerned with the quadrupolar coupling. A brief introduction to the theory of quadrupole resonance is also given. Author

N66-13137# Los Alamos Scientific Lab., N. Mex.
DETERMINATION OF TRACE AMOUNTS OF OXYGEN ADDED TO METALLIC SODIUM
K. S. Bergstresser, G. R. Waterbury, and C. F. Metz 24 Aug. 1965 32 p refs
(Contract W-7405-ENG-36)
(LA-3343) CFSTI: $2.00

Development and evaluation of a method for determining 1 to 10 ppm of oxygen in sodium metal is described in this progress report. A system was designed for maintaining a supply of low-oxygen sodium and for quantitatively separating, by vacuum distillation, metallic sodium from oxygen-containing impurities in portions of this metal. The nonvolatile residue was dissolved in dilute hydrochloric acid and analyzed with a flame spectrophotometer for sodium as an indirect measurement of the oxygen concentration, assuming that the distillation residue was sodium monoxide. To determine the reliability of the method, samples prepared by adding controlled quantities of oxygen, as water, to sodium metal were analyzed by the described method. The recovery of the added oxygen was quantitative, and the standard deviation of a single measurement was 0.5 ppm in the oxygen concentration range of 1 to 10 ppm. The method requires a minimum of transfer operations and has potential applications, and limitations, in connection with sodium reactor technology. Author

N66-13144# Brookhaven National Lab., Upton, N. Y.
THE ROLE OF OXYGEN IN SOLID STATE POLYMERIZATION. I: ACRYLAMIDE AND ITS SOLID SOLUTIONS
George Adler [1965] 25 p refs
(Contract AT(30-2)-GEN-16)
(BNL-9200)

It has been shown that the presence of oxygen has little effect on the ESR spectrum of acrylamide. On the other hand, the spectrum of propionamide is markedly changed and shows sharply increased decay rates with oxygen. The behavior of solid solutions of the two is intermediate and depends on the relative concentrations of the two materials. The polymerization is markedly decreased in the solid solutions when oxygen is present. The polymerization data is thus consistent with that derived from the ESR spectra. These effects are interpreted in terms of the crystal structure of the materials and the polymerization mechanism. Author

N66-13161*# Notre Dame Univ., Ind. Dept. of Chemistry.
FUNDAMENTAL STUDIES ON THE SYNTHESIS OF HEAT-RESISTANT POLYMERS. THE SYNTHESIS AND EVALUATION OF POLYMERIC SCHIFF BASES FROM XYLYLIDENE TETRAALKYL ETHERS Progress Report No. 7, 31 Jan.–15 Sep. 1965
G. F. D'Alelio 15 Sep. 1965 98 p refs
(Grant NsG-339)
(NASA-CR-68584) CFSTI: HC $3.00/MF $0.75 CSCL 07C

Black polymeric Schiff bases, which pass through a fusible stage, have been synthesized, from p-xylylidenetetra-n-butyl ether and either m- or p-phenylene-diamine or their benzylidene derivatives in the absence or presence of benzalaniline as a solvent. The differences between the polymers are small. The polymers derived from m-phenylenediamine and its benzylidene derivative have heat-resistance properties at least as high as those prepared from the para compounds and are equivalent to Schiff base polymers prepared by bis-Schiff base exchange reactions. The syntheses from the meta compounds proceed more smoothly than the para compounds. When the condensation of the reagents is carried to a temperature in the range of 425° C to 600° C, the heat-resistance of the best polymers is 550° C in air (1022° F), and 675° C (1247° F) in nitrogen. When the condensation is carried to a temperature of 1176° C, the best polymers show a heat-resistance of 600° C (1112° F) in air and 1176° C (2026° F) in nitrogen. Some secondary reaction appears to occur when the polymers are heated at above 600° C in nitrogen and the resulting polymers are not typical chars but retain their bright, shiny appearance. Author

N66-13178# Atomic Weapons Research Establishment, Aldermaston (England).
THE WATER VAPOUR CORROSION OF URANIUM AND ITS PREVENTION
V. J. Corcoran, C. Johnston, W. J. Metcalfe, and J. Thrope Jul. 1965 20 p refs
(AWRE-O-42/65) CFSTI: HC $1.00/MF $0.50

The reaction between uranium and atmospheres containing water vapor in the presence of nitrogen and oxygen has been studied at 25 and 40° C. The steady production of hydrogen from uranium and moist nitrogen was suppressed by the presence of gaseous oxygen, which itself was slowly consumed. The ability of sulphide and arsenic coatings to suppress hydrogen production from uranium in moist nitrogen was also investigated. Author

N66-13180# Oak Ridge National Lab., Tenn.
ON THE MODEL LAW FOR FILTRATION AND DETERMINATION OF THE FILTRATION RATE ON THE BASIS OF PERMEABILITY TESTS
Heinz Robel and Peter Güntzschel [1965] 18 p refs Transl. into ENGLISH from Chem. Tech. (Berlin), v. 17, no. 1, 1965 p 17–21
(ORNL-TR-743)

Six dimensionless characteristic factors are calculated from a formal dimensional analysis with nine of the most important influential values for the hydrodynamic process of filtration, where the porosity and specific surface of the cake were selected as structural values. By dropping two values which can be neglected and further recalculation of the remaining values, the problem of the filtrate flow through a cake of constant thickness can be reduced to a function f (Re; λ) = 0. Kafarow and Malinowskaja arrived at this function by a different method and obtained λ = 160/Re; our own tests confirm this result. The method of modeling the filtration process suggested by the Soviet authors is explained and discussed. Author

N66-13185# Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING MAY 31, 1965
D. E. Ferguson, R. G. Wymer, R. E. Blanco, K. B. Brown, M. E. Whatley et al Nov. 1965 324 p refs
(Contract W-7405-ENG-26)
(ORNL-3830) CFSTI: $7.00

The approaches to each program, and the studies and experiments conducted to achieve the overall objectives are summarized. The projects covered include power reactor fuel

processing; fluoride volatility processing; waste treatment and disposal; transuranium element, and curium processing; thorium fuel cycle development; separations chemistry research; fission products recovery by solvent extraction; chemistry of protactinium; irradiation effects on heterogeneous systems; high temperature chemistry; mechanisms of separations processes; chemical engineering research; reactor evaluation studies; chemical applications of nuclear explosions; preparation and properties of actinide element oxides; and molten salt reactor processing. The assistance provided by the Chemical Technology Division to other projects, such as the Eurochemic Assistance Program and projects for improving ORNL waste systems, is also discussed. A list of publications, speeches, and seminars is included.

M.G.J.

N66-13187# California Univ., Livermore. Lawrence Radiation Lab.

DEPOSITION OF TANTALUM FROM THE VAPOR PHASE [K VOPROSU OSAZHDENIYA TANTALA IZ PAROGAZOVOI FAZY]

Ya. M. Polyakov and G. Z. Zamesova Apr. 1965 11 p ref Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 4, 1964 p 130–134

(UCRL-TRANS-1211(L))

Experiments were conducted to determine the conditions for tantalum deposition by the reduction of $TaCl_5$ with hydrogen on a hot surface. It was noted that the deposition rate was maximum over a short length of the tube only, from the side of the gas–vapor mixture entry, and decreased thereafter; this nonuniformity was due to the increased concentration of HCl in the gas–vapor mixture as it traveled along the tube. Variations of the coating thickness and the relative change in the current with the time of deposition, and of the coating thickness with the relative change in the current are depicted. The chemical and structural compositions of tantalum deposits are also discussed. M.G.J.

N66-13188# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

AUTOMATED PROCEDURES FOR LITHIUM, COBALT, AND THORIUM AND THEIR APPLICATIONS IN NUCLEAR PROCESSES

R. H. Gaddy 4 Aug. 1965 27 p refs

(Contract AT(07-2)-1)

(CONF-650919-1)

The following applications of the AutoAnalyzer are described: lithium in Tramex process (flame photometry), cobalt in Al–Co neutron flux monitor wires (colorimetry), and thorium in Thorex process (colorimetry). Reagents and procedures are given. NSA

N66-13192# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

SYNTHESIS OF HYDRAZINE-FLUOROZIRCONATES (IV) [DIE SYNTHESE VON HYDRAZINIUM-FLUOROZIRKONATEN (IV)]

J. Slivnik, A. Smalc, B. Sedes, and M. Vilhar Jul. 1964 4 p refs In GERMAN

(NIJS-R-430) CFSTI: HC $1.00/MF $0.50

Crystals from an evaporated, mole/equivalent solution of hydrazine (2+) fluoride and zirconium dioxide in hydrofluoric acid underwent chemical and thermogravimetric analyses. Crystal composition was established as $N_2H_6ZrF_8$, consisting of: 13.4% N_2H_4, 38.3% Zr; and 47.4% F. Condensation of the same solution in a molar ratio of 4.5:2 resulted in crystals of trihydrazine (2+)-bis(heptafluorozirconate(IV)) with the following composition: 17.5% N_2H_4; 33.3% Zr; and 48.4% F. All results showed good agreement with calculated values.

Transl. by G.G.

N66-13193# Commissariat a l'Energie Atomique, Grenoble (France).

SEALED COUPLING FOR AN ELECTRICAL HEATING CONDUCTOR WITH COAXIAL SHEATH [RACCORD ETANCHE POUR CONDUCTEUR ELECTRIQUE CHAUFFANT A GAINE COAXIALE]

Philippe Arragon, Robert Aubert-Chevallier, Jean Gentil, Maurice Seguin, Marc Vilcot et al Mar. 1965 14 p refs In FRENCH

(CEA-R-2755) CFSTI: HC $1.00/MF $0.50

Presented is the development of a sealed electric coupling to withstand high gamma radiation environment in nuclear devices. Performance data are included. Transl. by Y.S.

N66-13198# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.

PYROLYSIS AND OXIDATION OF FORMALDEHYDE IN SHOCK WAVES

Ian D. Gay, Graham P. Glass, George B. Kistiakowsky, and Hiromi Niki Jul. 1965 25 p refs Submitted for Publication

(Contract Nonr-1866(38))

(AD-469061)

The pyrolysis and oxidation of formaldehyde have been studied in shock waves by mass spectrometry and by ionization measurements over the temperature range 1400 to 2100° K. The pyrolysis shows first order rate dependence with respect to both formaldehyde and inert gas after a temperature dependent induction period. Experiments with formaldehyde-d_2 show that the pyrolysis proceeds by a radical chain mechanism. The formation of the radical H_3CO has been detected. The observed activation energy is 28 ± 2.5 kcal/mole; various mechanisms are suggested to explain this result. The initial stage of the oxidation consists mainly of an oxygen induced decomposition of formaldehyde into CO and H_2, followed by branching chain oxidation of the H_2 so produced as well as remaining formaldehyde and partial oxidation of the CO. Chemi-ionization is observed in the oxidation reaction, the species H_3O^+ and H_3CO^+ being the only ions detected. The total yield of ions is virtually independent of temperature. The mechanism of the oxidation reaction and of ion formation is discussed. Author (TAB)

N66-13207# Naval Applied Science Lab., Brooklyn, N. Y.

DETECTION OF UNSYMMETRICAL DIMETHYLHYDRAZINE Progress Report

Manfred J. Prager [1965] 14 p

(PR-1; AD-619887)

The leakage of propellants from missiles in shipboard spaces is a potential hazard to ship's personnel. It is essential to develop systems that can detect and automatically alarm to hazardous concentrations of such materials. The detection of the fuel UDMH (unsymmetrical dimethylhydrazine) was studied by gas chromatography and FMIR (frustrated multiple internal reflectance spectroscopy). By means of a gas chromatograph equipped with a flame ionization detector, 3 ppm of UDMH in air could easily be detected in 20 seconds. The data indicated that the desired sensitivity of 0.5 ppm was attainable. By means of FMIR, 10 micrograms UDMH in benzene could be detected, but whether such small quantities can also be detected in air has not yet been determined. Author (TAB)

N66-13219# American Cyanamid Co., Stamford, Conn. Central Research Div.
CHEMILUMINESCENT MATERIALS Technical Report No. 9, 1 Jun.–31 Aug. 1965
M. M. Rauhut, L. J. Bollyky, R. A. Clarke, M. Loy, B. G. Roberts et al 30 Sep. 1965 80 p refs
(Contract Nonr-4200(00); ARPA Order 299)
(Rept.-06-1432-25-Q9; AD-621845)

Progress toward the development of chemiluminescent systems for application to chemical lighting is reported. A mechanistic study of the chemical processes involved in the oxalyl chloride-hydrogen peroxide-fluorescer chemiluminescent reaction was completed and the mechanism of the reaction is discussed. A preliminary study is reported on the effects of reaction conditions on chemiluminescent intensities, lifetimes, quantum yields and radiation capacities of oxalic anhydride and oxalic ester reactions with hydrogen peroxide in the presence of 9,10-diphenylanthracene. Quantum yields were found to decrease with increasing concentration of the oxalic acid derivatives. A series of sixteen oxalic esters were examined qualitatively for chemiluminescence under a variety of reaction conditions. Superior results were found for esters containing electronegative substituents. Reactions of 5-hydroxytetrazole, octahydroxycyclobutane, and related compounds with hydrogen peroxide in the presence of 9,10-diphenylathracene were not chemiluminescent. Author (TAB)

N66-13220# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
INTERCALATION OF THE RARE EARTH ELEMENTS INTO GRAPHITE AND DICHALCOGENIDES
William Ernest Craven (M.S. Thesis) Aug. 1965 74 p refs
(GNE/PH/65-02; AD-621029)

The graphite intercalation compounds of cerium, samarium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, and ytterbium were prepared by reacting powdered graphite with the solution of the metal in liquid ammonia. Electrolysis was necessary to dissolve all but ytterbium. Intercalation compounds of ytterbium and samarium with the dischalcogenides: WS_2, WSe_2, and MoS_2, were prepared by the same process. The X-ray diffraction patterns showed that mixtures of several stages were present in the graphite compounds. Magnetic susceptibility measurements indicated that most of the rare earths intercalate in the trivalent state, the exception being divalent samarium. Apparently ytterbium exists in both divalent and trivalent states in the compound. Author (TAB)

N66-13298*# National Aeronautics and Space Administration, Washington, D. C.
ELECTRON PROBE MICROANALYSIS OF LIGHT ELEMENTS [LE DOSAGE DES ELEMENTS LEGERS PAR LE MICROANALYSEUR A SONDE ELECTRONIQUE]
R. Castaing and J. Descamps Dec. 1965 32 p refs Transl. into ENGLISH from Rech. Aeron. (Chatillon-sous-Bagneux), no. 63, 1958 p 41–52
(NASA-TT-F-9811) CFSTI: HC $2.00/MF $0.50 CSCL 07B

The proportional analysis of light elements in various alloys, cosmic magnetic spherules, and marine sediments by electron probe microanalysis is described, with structural details on the microanalyzer used and photomicrographs of the investigated specimens. The relative accuracy of analysis with the described apparatus is 1% at high concentrations of the elements, permitting a detection of contents as low as 0.02%. The accelerating potential is kept to the minimum compatible with the correct excitation of the characteristic lines of the elements, so as to keep the diffuse penetration of elements in depth within the specimen to a minimum. To prevent atmospheric contamination, the gas pressure was kept slightly above 1 atm. Corrections to be made for absorption and for secondary fluorescence of X-rays within the specimen are formulated. Application of the method is checked on several typical examples, including the Mg_2Si phase in an Al-Mg-Si alloy. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-12183*# Dalmo Victor Co., Belmont, Calif.
QUASI-ISOTROPIC SPACECRAFT ANTENNA SYSTEM Final Report
Kenneth A. Green, John R. Wood, and Victor Galindo Pasadena, Calif., JPL, Calif. Inst. of Tech., 30 Jun. 1965 176 p refs Revised
(Contract NAS7-100)
(NASA-CR-68124; R-2870-3582-B) CFSTI: HC $5.00/MF $1.00 CSCL 09F

This report describes in detail the results of a study and development program leading to a spacecraft quasi-isotropic antenna system for space telemetry. Two antennas are employed with an automatic logical switching system to assure right circularly polarized spherical pattern coverage at near isotropic gain. The principal antenna provides right circularly polarized coverage over the maximum area theoretically possible and can easily be adapted to any 10 per cent band from 1 to 10 Gc. The switching logic, which is designed to operate with one or two receivers and one transmitter, will assure a closed loop telemetry path through the better antenna. Several modes of operation maximize reliability for a given weight. Author

N66-12204* National Aeronautics and Space Administration, Washington, D. C.
LOSS OF INFORMATION DUE TO FREQUENCY DISTORTIONS
Yu. P. Drobyshev *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 14–23 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Noise rather than frequency distortion is considered the cause of frequency-dependent losses over a communications channel. It is assumed that the channel represents some linear filter with specified frequency characteristics, and contains noise which is frequency-independent and has a constant specific power. Carrying capacity of an ideal filter and for the case of an arbitrary frequency characteristic are given; and it is shown that loss of information between input and output can be evaluated from change in carrying capacity. Details are given for a method to determine loss for an ideal filter and for one with linearly increasing frequency characteristics. It is pointed out that in actual practice the determination of information loss may become difficult because of the nonperiodic nature of the pulse characteristics, effect of phase distortions, and frequency dependency of noise. Magnitude of such errors and carrying capacity of the channel may be determined experimentally by measuring pulse characteristics of the channel. M.W.R.

N66-12205* National Aeronautics and Space Administration, Washington, D. C.
CENTROTECHNIQUE

F. Ye. Temnikov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 24–29 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Organizational completeness of a three-step information system for conventional industrial enterprise is achieved by Centrotechnique-3, a conveyor type system with three industrial levels: object, works of production, and plant or combine. Within the entire serviced territory, a single active network of code circulation uses either a multiple conductor telephone cable or a two-conductor or radio link. Equipment of the workshop centers is simplified by centralization of a series of important transformation loops; the code circulation network is serviced by the central scan loop; and a central information machine replaces dispatch boards and panels. It is proposed that a digital computer be used at the plant center to compute technical and economic parameters. Communication for Centrotechnique-3 is established by means of conveyor ring channels and by a radial channel which transmits marker signals. Capacity of each workshop center is 500 points of control; that of the plant center is not limited although it typically is equal to 500 control points. Scan cycle time for a quantity is automatically varied from one to six seconds. M.W.R.

N66-12207* National Aeronautics and Space Administration, Washington, D. C.
TELEMETERING DEVICES WITH AUTOMATIC COMPENSATION
S. V. Alekseyev *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 34–37 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

The application of compensating signals can be used to produce telemetric devices with automatic compensation into the functions defining the state of the communications channel. A multichannel amplitude device with frequency separation of channels and automatic compensation is illustrated as is a pulse amplitude device with time separation. Amplitude of compensating pulse can be selected so that it is greater than the maximum amplitude of the significant pulse; in this way, the relay of the compensating pulse will be energized only by compensating pulses. M.W.R.

N66-12214* National Aeronautics and Space Administration, Washington, D. C.
SELECTING SUB-CARRIER FREQUENCIES IN HIGH SPEED MULTI-CHANNEL FREQUENCY TELEMETERING SYSTEMS
S. V. Alekseyev *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 89–92 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

A relationship is recommended for selecting the subcarrier frequencies in high speed multichannel frequency telemetering systems, and it is recommended that some corrections should be introduced to compensate for intermodulation distortion. Variation of zero frequency is shown as a function of the sequence number of the channel. M.W.R.

N66-12215* National Aeronautics and Space Administration, Washington, D. C
CHAIN-RING METHOD OF CODING
I. A. Nabiyev and M. S. Granovskiy *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 93–97 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Although the chain-ring transformation of the binary code provides for utilization of $b>2$ signs, it cannot be considered as b-th coding because of its binary principle. Each of the symbols can assume only two values, which depend on the values of the preceding symbol. The $b>2$ pulse signs are used because it is necessary to note the functional relationship of symbols in a binary combination. Chain-ring combinations are considered, as are methods for correcting distortion. It is pointed out that shortcomings in using the chain-ring method are associated with the need to introduce a large number of pulse signs. M.W.R.

N66-12293# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.
EVALUATION OF AIRBORNE RADIO FREQUENCY INTERFERENCE DETECTION SYSTEM Final Report
William E. Gibbons Aug. 1965 43 p refs
(RD-65-14)

This report contains the results of the evaluation of an airborne radio frequency interference detection system conducted to determine the suitability of the system in detecting, identifying and locating radio frequency interference signals affecting the air traffic control communications and navigation facilities. The system presented a panoramic display of the frequency band under consideration and the audio modulation of a selected portion of that band for signal analysis. Through directional antennas and antenna switching, the direction to a selected signal source was indicated. An airborne terrain camera recorded the aircraft track over the source. The panoramic and audio presentations could be recorded for subsequent analysis. Author

N66-12329# Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.
OPTIMUM RADAR SURVEILLANCE MODE STUDY PROGRAM Final Report, Apr. 1964–Feb. 1965
Harold M. Finn Griffiss AFB, N. Y., RADC, Sep. 1965 144 p refs
(Contract AF 30(602)-3152)
(RADC-TR-65-77; AD-621716)

A second-phase study of radar multiple-stage decision processors which minimize the average transmitter power and data processing costs for performing the surveillance mission is described. Energy Variant Sequential Detector (EVSD) theory is reviewed. A sequential detection scheme for performing high-resolution surveillance missions where relatively large time-bandwidth products are involved is described. These modes (designated as Resolution-Variant EVSD's) use the programmed control of the time-bandwidth product of the transmitted signal, the transmitted energy, and the receiver thresholds on the sequential steps employed in order to minimize both the transmitter power and the parallel signal processing costs. General implementation of EVSD's are reviewed. The optimum scan time to be used when EVSD's are employed for each scan look is developed for both the case where the target is pointing directly at the radar, and the second case where the target range is assumed relatively constant for the time duration in the surveillance volume. EVSD modes which include an option on the time interval between sequential steps are described, and the additional power savings over the use of a conventional EVSD are computed. TAB

N66-12350# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR ECHO VARIATIONS OF A LARGE ROUGH SPHERE
Michael L. Burrows 14 Sep. 1965 27 p refs
(Contract AF 19(628)-5167)
(TN-1965-46; ESD-TDR-65-449; AD-621568)

The effect of surface roughness on the radar back-scattering cross section of a perfectly conducting nominally spherical target is examined by applying the Kirchhoff method. It is shown that, for the type of roughness and sphere size to which the Kirchhoff method is applicable, the standard deviation of the cross section increases with frequency according to the law 2 square root of $(2\Sigma_0)$ K zets until the first Fresnel

zone reduces in size to the scale length of the roughness. At this point a knee in the curve occurs and its further course is determined by a more detailed statistical description of the surface. Here Σ_0 is the nominal cross section, zeta is the standard deviation of the surface height h and k = 2 lambda where lambda is the wavelength. Some experimental results are reported which support the theoretical conclusions and, moreover, indicate that they may be useful even when the scale length of the roughness is smaller than the wavelength. Further theoretical results are included concerning the effect of roughness on a general second order surface and the correlation function for the cross section. Author (TAB)

N66-12400# Arizona Univ., Tucson.
FURTHER EXPERIMENTAL STUDY OF PLASMA SHEATH EFFECTS ON ANTENNAS
John M. Hamm and George Tyras Jul. 1965 41 p refs *Its* Sci. Rept.-2
(Contract AF 19(628)-3834)
(AFCRL-65-608; AD-621751)

The plasma sheath simulation technique developed earlier was used to investigate the effects of various types of sheath discontinuities and inhomogeneities on a slot antenna radiation pattern and input impedance. In the case of semi-infinite and finite-extent homogeneous plasma sheaths, the radiation pattern and the impedance characteristic are investigated with regard to the geometry of the discontinuity and its proximity to the slot antenna. It is found that the radiation pattern is unaffected by the discontinuity as long as the ratio of the distance between the source and the discontinuity to the sheath thickness is of the order of 20 or greater. When the sheath is made finite in extent, with a discontinuity on each side of the slot, the resulting pattern is seen to be a superposition of the effects of each discontinuity acting separately. The effects produced by inhomogeneities are found to be simular to those of a homogeneous sheath with a certain equivalent dielectric constant. For both the homogeneous and inhomogeneous sheaths, favorable comparison with the available theory is obtained. Author (TAB)

N66-12437# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
NUMERICAL VALUES OF THE PATH INTEGRALS FOR LOW AND VERY LOW FREQUENCIES
Leslie A. Berry and Mary E. Chrisman 2 Sep. 1965 110 p refs
(NBS-TN-319) GPO: $0.55

Numerical values of the path integrals for the first five hops are given as a function of distance from 1000 km to 8000 km, for frequencies of 10, 20, 30, 60, 100, 150, and 200 kHz, for sea paths, and for land paths with conductivities of 0.01 and 0.001 mhos/m, assuming reflection heights of 60, 70, 80, 90, and 100 km. For convenience, ground wave curves for the same parameters are given. Using these values, and any ionospheric reflection coefficients, the individual time modes, and the total field can be calculated simply. The calculation is valid near the caustic and in the shadow region. The path integrals can also be used to extract ionospheric reflection coefficients from experimental data. Author

N66-12442# Joint Publications Research Service, Washington, D. C.
CONDITIONS AFFECTING THE RESOLVING POWER OF RADIO TELESCOPES AND RADIO INTERFEROMETERS
N. L. Kaydanovskiy and N. A. Smirnova 30 Nov. 1965 17 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 10, no. 9, Sep. 1965 p 1574–1582
(JPRS-33088; TT-65-33665) CFSTI: $1.00

The effect of conditions for radio wave propagation in the earth's atmosphere and in outer space on the maximum resolving power of antennas and interferometers is examined. Phase deformation of the frontal wave is calculated, and tentative values of such significant parameters as the mean square deflection of the refractive index, the correlation range (mean value of the nonhomogeniety), and the path of the beam through the medium are tabulated for various media. Formulas are also given for determining the angular expansion of a source. Based on these data, a calculation was made and plotted to show how maximum resolving power (in seconds of arc) can be attained with continuous antennas and with interferometers but in different wave bands. It was concluded that the diameters of antennas can, in practice, be unlimited in the centimeter range and for the shorter decimeters, and that the resolving power of radio-telescopes in the millimeter range varies from time to time. M.G.J.

N66-12449# Environmental Science Services Administration, Boulder, Colo. Central Radio Propagation Lab.
THEORY OF A SLOTTED-SPHERE ANTENNA IN COMPRESSIBLE PLASMA, PART III Scientific Report No. 28 (III)
J. R. Wait and K. P. Spies 11 Aug. 1965 28 p refs *Its* SR-28
(Contract PRO-65-504)
(AFCRL-64-472(III); AD-621712)

Numerical results are presented for the conductance and acceptance of a slotted-sphere antenna which is immersed in a compressible, isotropic, and lossless electron plasma. Previous series expansions for the parameters of interest are cast in a form suitable for numerical work. The results indicate that an appreciable fraction of the power radiated is in the form of electroacoustic waves. However, this fraction may be significantly reduced if the sphere is surrounded by an electron depletion layer whose thickness is somewhat greater than a Debye length. Author

N66-12476# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
DEVELOPMENT OF PRECISION VHF OMNIRANGE Final Report
B. Gold, E. Hollm, J. Lovell, R. Mesard, and M. Zeltser Dec. 1964 105 p refs
(Contract FAA-ARDS-553)
(RD-64-29)

The Precision VHF Omnirange (PVOR) consists of an International Civil Aviation Organization (ICAO) standard VOR that has been modified to transmit additional precision multilobe bearing information on the same channel. A standard airborne navigation receiver with a PVOR converter automatically resolves the ambiguities of the multilobe signal. An unmodified navigation receiver continues to use only the standard portion of the signal with no degradation in performance. Flight tests of the PVOR combined with a four-loop VOR and with a Doppler VOR indicate an improvement in system accuracy of better than 5 to 1. The overall reduction in siting effects is slightly better than that obtained with a Doppler VOR. The multilobe principle provides a potential 13-fold improvement in instrumentation and monitoring accuracy. The system described is a feasibility model. It is recommended that further effort be expended on an engineering model of a complete system, including monitoring and calibration equipment. Author

N66-12503*# Dorne and Margolin, Inc., Westbury, N. Y.
THE DESIGN OF AN OMNIDIRECTIONAL ANTENNA SYSTEM FOR THE APOLLO SPACECRAFT

Arthur Dorne, Eugene Shube, Ray Anderson, and Louis Leopold
22 Sep. 1964 236 p refs *Its* Rept.-1791.1
(Contract NAS9-2286)
(NASA-CR-65178) CFSTI: HC $6.00/MF $1.25 CSCL 09F

A study was carried out to select an approach to the design of an omnidirectional antenna system for the Apollo Command module. It was concluded that radiating elements embedded in fused silica blocks installed in the ablative shield, would best meet the requirements. A laboratory prototype was made of each of the nine different versions of this kind of antenna that a complete system would require. These prototypes are described and their performance characteristics presented. Scale model radiation pattern measurements, using a one-fourth scale model of the vehicle, were also performed. Based upon these measurements recommendations for the location of the antennas upon the capsule are made. Author

N66-12514# New York Univ., N. Y. Lab. for Electroscience Research.
FINITE MEMORY NONLINEAR FILTERING OF DIGITAL SEQUENCES Final Report, Part I, 1 Sep. 1964–31 Aug. 1965
Jack K. Wolf 1 Oct. 1965 14 p refs
(Contract DA-31-124-ARO-(D)-253)
(AROD-4949-2; AD-621801)

The autocorrelation function of sequences generated by the non-linear filtering of binary maximal length sequences are derived. It is shown that the autocorrelation function of the filtered sequences, which are recognized as interleaved sequences, are similar to the autocorrelation function of the original maximal length sequence except for the addition of minor peaks. Other problems considered are the cross-correlation functions of interleaved two-level sequences, binary and non-binary sequences, binary and non-binary sequences orthogonal for all cyclic shift, the performance of an asynchronous multiple-access system and the hard limiting of non-binary sequences. Author (TAB)

N66-12520# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A CIRCULAR SLOT ANTENNA FOR USE ON IONOSPHERIC PROBES
B. N. Cuffin 15 Sep. 1965 70 p refs
(Grant DA-ARO(D)-31-124-G659)
(SR-249; AD-621474)

An analysis of an empirically designed circular slot antenna is presented. The radiation patterns of the actual antenna are shown and compared to the patterns predicted by a theoretical model that is developed. Possible reasons for some of the difference between the results are indicated. TAB

N66-12565# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MILLIMETER WAVE RESEARCH: PAST, PRESENT, AND FUTURE Technical Report No. 389
James W. Meyer 17 May 1965 25 p refs
(Contract AF 19(628)-500)
(ESD-TDR-65-72; AD-620727)

This report is the edited transcript of a seminar given at Lincoln Laboratory on 2 March 1965. The cyclicity of interest in millimeter wave research is traced from the time of Hertz, when investigations of this part of the electromagnetic spectrum began. The waxing and waning of millimeter wave research are traced as exciting new fields are discovered which diverted the interest of physicists. Each re-emergence of millimeter wave research has been more robust, often because the results of the diversions were important to improved techniques. Early millimeter wave apparatus is described. The narrative of the development of a millimeter wave radar for the detection of the moon relates the opening of this spectral region to radar astronomy. Other applications are mentioned, along with future possibilities. A chronology, a list of large millimeter wave antennas, and a bibliography of review papers are included. Author (TAB)

N66-12578# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
BEACON VIDEO DEFRUITING EQUIPMENT Final Report
P. G. Holcombe Aug. 1965 27 p refs
(Contract FA-WA-4624)
(RD-65-87)

The Beacon Video Defruiting Equipment is, in essence, a synchronous detector, which is constructed of transistor circuitry and storage tubes. The purpose of the equipment is to remove nonsynchronous signals from the beacon video replies in the Air Traffic Control Radar Beacon System. During operation, complete independence of the radar PRF and the beacon mode interlace ratios is maintained. Author

N66-12585# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
EARTH-TO-SPACE COMMUNICATIONS AT MILLIMETER WAVELENGTHS
Edward E. Altshuler Aug. 1965 39 p refs *Its* Phys. Sci. Res. Papers No. 125
(AFCRL-65-566; AD-621942)

It is expected that with the exploration of outer space, a requirement for high data rate earth-to-space communication channels will arise. A program to investigate the feasibility of using the millimeter-wave region of the spectrum for this application is presented. The theory of atmospheric attenuation resulting from losses due to absorption, scattering and refraction processes is reviewed and used to estimate propagation losses produced by atmospheric gases, clouds and precipitation. Curves of total atmospheric attenuation and noise level as a function of meteorological parameters and antenna elevation angle are also presented. A series of experiments designed to obtain as much information as possible on the limitations imposed by the atmosphere on millimeter-wave propagation is considered. Although experiments using natural celestial bodies such as the sun, moon, planets and galaxies as radio sources are emphasized, those which would utilize aircraft, rockets and satellites are also mentioned. Finally, the characteristics of a recently installed precision 29-ft antenna designed to operate at 35 Gc (wavelength = 8.6 mm) with a traveling-wave maser as a preamplifier for the radiometer are outlined along with the specific experiments for which this antenna system will be used. Author (TAB)

N66-12597# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A GENERALIZED MELLIN TRANSFORM FOR THE ANALYSIS OF LEARNING MACHINES
Bruce Allen Dolan [1965] 138 p refs
(AIFT-TR-65-9; AD-620881)

This work introduces a generalization of the Mellin integral transform, and then applies it as a new technique for the analysis of statistical learning machines. Specifically, this transform technique is demonstrated for Bayes' estimation and binary detection of communication signals in the framework of statistical decision theory. It is shown that the use of the Mellin transform markedly simplifies the analysis of sequential estimation of an unknown parameter in a statistical population, whether or not an optimum (admissible) decision rule is used for processing the observations. The loss function, which need not be error-squared, or the likelihood ratio is treated

as a random variable, and is described by a transform expression derived from the basic Bayes' learning or estimation equation. This transform expression for the loss is the Mellin transform pair to the probability density of the loss, and contains, as unspecified parameters, the number of observations, the a priori assumptions about the unknown parameter that is to be estimated, and the decision (data processing) rule. The transform expression for the loss is shown to be a convenient and appealing measure of the performance of the learning machine. Convergence, bias, and the rate of convergence of the estimation procedure are readily displayed through the transform associated with the loss function. The average cost of errors for a binary detector, previously adapted through the use of sequential estimation, is derived through the convolution integral and Parseval's relationships for the Mellin transform. Author (TAB)

N66-12601# Sperry Microwave Electronics Co., Clearwater, Fla.

DEVELOPMENTAL ATC RADAR BEACON SYSTEM GROUND STATION PERFORMANCE MONITOR Final Report

George W. Pate and W. G. Funke Dec. 1964 76 p
(Contract ARDS-456)
(SRDS-RD-64-152; AD-619510)

The ATC Radar Beacon System Ground Station Performance Monitor is designed to provide alarm indications to maintenance and operating personnel should any of the various system parameters deviate beyond acceptable operational limits. In addition, the monitor provides a confidence check on the operation of the ground station decoder and azimuth presentation accuracy by providing a simulated reply code train through a test antenna located at a known azimuth position. The decoded simulated reply is observed on the operators PPI as a direct confidence check. The monitor is a dual monitor providing two complete monitor channels. Logic and switching circuitry is provided which may be utilized to switch monitors in the event of an alarm; automatically switch systems between the active ATC transmitter-receiver and the standby transmitter-receiver in the event of an alarm in the active system or automatically take control of the standby system for periodic monitoring, etc. This report summarizes program activity through the acceptance test phase at the National Aviation Facilities Experimental Center. Observations of the system-monitor combination during the acceptance phase have provided the background for recommendations directed at reducing the monitor complexity and increasing the monitor effectiveness. Author (TAB)

N66-12610 Ohio State Univ. Research Foundation, Columbus.

PHOTOGRAMMETRIC MEASUREMENTS OF ECHO II SATELLITE MODELS

Forrest Llewellyn Hicks (M.S. Thesis) 1965 67 p refs
(Contract AF 33(608)-1095)
(AD-620432)

Stereoscopic photographs were taken of several models of the Echo II satellite using the Wild Stereometric camera. Large and small scale work was accomplished on the Wild Autograph A7, including contour maps and coordinate readout. Data were processed to achieve final results which included cross sections, radii of curvature, deviations from best-fitting spheres, and distances above a one-meter chord. Author (TAB)

N66-12780# Electro-Mechanical Research, Inc., Sarasota, Fla.

TELEMETRY FM/FM BASEBAND STRUCTURE STUDY, VOLUME II Final Report

E. B. Campbell and W. R. Herbert 14 Jun. 1965 339 p
(Contract DA-29-040-AMC-746(R))
(AD-621140)

This volume contains the procedures used and data measured as part of a baseband expansion study. In essence, the program consisted of an evaluation of equipment, a study to determine a feasible baseband expansion, and a program of experimentation to evaluate expansion and provide recommendations for systems application. Telemetry equipment representative of that typical in field use was gathered and evaluated to determine if there were any characteristics which would prohibit its use in an FM/FM baseband expanded in frequency to 200 kc. Those parameters which were thought to contribute to total system error were also evaluated. Parameters such as receiver IF-envelope delay variation, transmitter dynamic linearity, tape-recorder harmonic distortion, etc., were measured. Where possible, similar units from different manufacturers were obtained. In order to determine the feasibility of the recommended expansions of the FM/FM basebands, a complete laboratory telemeter was constructed and several basebands were evaluated using specific system tests. The system tests included experimental optimization of the transmitter pre-emphasis, intermodulation, signal-to-noise and system error tests. Determination of the effect of post detection recording, system accuracy, and applicability for pulse modulation were considered as well. Author (TAB)

N66-12802# North Electric Co., Galion, Ohio.

STUDY OF AUTOMATIC ROUTING IN A SWITCHED SYSTEM UTILIZING SATURATION SIGNALING Third Quarterly Report, 1 Jan.–31 Mar. 1965

H. Hambrock, L. Robinson, H. Rondina, R. Starr, S. Sternung, et al [1965] 100 p refs
(Contract DA-28-043-AMC-00342(E))
(Rept.-3; AD-622610)

Results of a study to determine the feasibility of utilizing saturation signaling in automatic routing are reported. A discussion and function flow chart of a signal saturation switching center capable of handling digital information at 38.4 Kb/sec. transmission rate is presented. Possible signal formats for priority, multiple addressee data messages, and conference voice calls are shown. A command-area communications network utilizing signaling concepts at analog switching speeds of 1.1 sec. was simulated. The reference network for direct routing, an area network (Network A), is defined. This network was obtained by iterating the direct routing simulator while changing the number of trunks assigned to links until the grade of service and uniformity conditions were met to within random variability of the applied voice and data traffic, priority included. M.R.W.

N66-12864# Joint Publications Research Service, Washington, D. C.

COMMUNICATIONS CHANNELS

N. M. Bosby 13 Oct. 1965 289 p refs Transl. into ENGLISH of the book "Kanaly Svyazi" Kiev. State Publishing House for Tech. Lit., 1963 p 1–392
(JPRS-32369; TT-65-32859) CFSTI: $6.00

The principles of information theory, transmission over wire circuits, quadripoles, and electrical filters are presented. Operative communications in industry, telephonic remote control channels and digital automation channels using wire, radio, and electrical transmission lines were also examined. Other data mentioned are four-pole networks, multichannel communications systems, radio relay communications, and the developmental outlook in communications technology. R.W.H.

N66-12975*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL/THEORETICAL EVALUATION OF A PASSIVE COMMUNICATIONS SATELLITE (ECHO II)
A. Kampinsky and R. K. Ritt (Conductron Corp., Ann Arbor, Mich.) Aug. 1965 52 p refs Presented at U.R.S.I. 1965 Symp. on Electromagnetic Wave Theory, Delft, Netherlands
(NASA-TM-X-56996) CFSTI: HC $3.00/MF $0.50 CSCL 17B

Methods developed to predict the radar reflectivity of the Echo II passive communications satellite are described, and their subsequent use in analyzing the data obtained during orbital flight is discussed. A technique was evolved for evaluating the backscatter characteristics of a small segment of the structure, in terms of inherent physical distortions based on the physical construction and the resultant scintillation and communications distortions. Based on these data, theoretical models were constructed. Prior to flight, full size inflated Echo II spheres were evaluated to show the relationships between the skin–stress–scintillation level backscatter qualities. After orbital injection, 20 radar systems provided frequency coverage from VHF to X band, and real time as well as digitized tape radar records of the backscatter qualities. Statistical analyses of these data are included, and the results depicted. The differential equations of equilibrium thin membrane theory are given, and alternatives for developing predictions of full-scale balloon reflectivity are outlined. M.G.J.

N66-13010*# Hughes Research Labs., Malibu, Calif.
ROUTING AND ECONOMIC PRINCIPLES OF MULTIPLE ACCESS SATELLITE COMMUNICATION
Samuel G. Lutz Apr. 1964 109 p refs *Its* Res. Rept.-303
(Contract NASw-495)
(NASA-CR-68296) CFSTI: HC $4.00/MF $0.75 CSCL 17B

Multistation random access satellite communication techniques and the present status of communication satellites are discussed as background. The subsequent portions of the report examine the routing aspects of a random access system, the economic aspects of earth stations, and the economic break-even relations between satellite and surface communication. The economic constraints on random access stationary satellite communication differ from those on surface systems in ways which may mean that such a communication method will best meet the needs of areas having low surface communication densities. This form of satellite communication also should lead to simpler and more direct routing between distant subscribers than has been the practice with multichannel surface communication techniques. Author

N66-13090*# ADCOM, Inc., Cambridge, Mass.
COMMAND SYSTEM STUDY FOR THE OPERATION AND CONTROL OF UNMANNED SCIENTIFIC SATELLITES, TASK III: COMMAND SYSTEM INTERFERENCE Third Quarterly Progress Report, 1 Jan.–31 Mar. 1965
P. A. Bello, A. M. Manders, and J. M. Sussman [1965] 52 p refs
(Contract NAS5-9705)
(NASA-CR-68414) CFSTI: HC $3.00/MF $0.50 CSCL 17B

This report covers progress during the reporting period of the Command Systems Study for the Control of Unmanned Scientific Satellites under Task III Command System Interference. The report contains a review of performance above threshold of AM, FM, and DSBSC modulation. An analysis of error rate degradation below threshold is presented for an FSK channel appearing as one of the subcarriers in an FDM/FM system. The effect of CW and modulated interference on the baseband of AM and FM demodulators is treated. An improved AGC circuit is described for overcoming the desired signal attenuation relative to its level without interference. Test procedures for evaluating the effects of CW interference are outlined. Author

N66-13154*# Planning Research Corp., Los Angeles, Calif.
GEOS A TELEMETRY SUBSYSTEM RELIABILITY ASSESSMENT Technical Advisement Memorandum No. 106-11
Winifred C. Graham and Charles E. Bloomquist 8 Oct. 1965 21 p refs
(Contract NASw-1180)
(NASA-CR-68465; PRC-D-1116) CFSTI: HC $1.00/MF $0.50 CSCL 09F

In assessing the GEOS-A telemetry subsystem, an engineering analysis was performed, including a failure mode and effect analysis. Since the telemetry is not used for transmitting experiment results, the telemetry data are composed solely of operational information on the spacecraft equipment. The commutated data and related hardware are described, along with the memory readout and time marker. A functional block diagram, and a logical representation of the commutator are included. Results of the failure mode and effect analysis are summarized, and the potential problem of not recognizing failure states from the telemetry data is discussed. Based on this information, the subsystem was modeled, and effectiveness figure-of-merit numerics were calculated. Results show that the design and implementation of the subsystem is adequate, and that the expected proportion of telemetry subsystem capability available at the end of a year is approximately 54 percent. M.G.J.

N66-13166*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
THE COMPUTATION PROBLEM WITH SEQUENTIAL CODING Technical Report No. 439
J. E. Savage 16 Feb. 1965 78 p refs Lincoln Lab. Tech. Rept. no. 371
(Grants NsG-334; NsG-496; NSF GP-2495; Contracts DA-36-039-AMC-03200(E); AF 19(628)-500 et al)
(NASA-CR-68542) CFSTI: HC $3.00/MF $0.75 CSCL 09D

Fano sequential decoding is a technique for communicating at a high information rate and with a high reliability over a large class of channels. However, equipment cost and variation in the time required to decode successive transmitted digits limit its use. This work is concerned with the latter limitation. This report studies the probability distribution of the processing time random variable and applies the results to the buffer overflow probability, i.e., the probability that the decoding delay forces incoming data to fill and overflow a finite buffer. It is shown that the overflow probability is relatively insensitive to the buffer storage capacity and to the computational speed of the decoder, but quite sensitive to information rate. In particular, halving the source rate more than squares the overflow probability. These sensitivities are found to be basic to sequential decoding, and arise because the computation per decoded digit is large during an interval of high channel noise and grows exponentially with the length of such an interval. A conjecture is presented concerning the exact behavior of the overflow probability with information rate. This conjecture agrees well with the limited experimental evidence available. Author

N66-13172*# Energy Systems, Inc., Palo Alto, Calif.
TRANSMITTERS, TELEVISION "S" BAND SYSTEM Quarterly Progress Report
Don Mamayek and G. E. Tallmadge 1 Oct. 1965 21 p
(Contract NAS8-11990)
(NASA-CR-68506) CFSTI: HC $1.00/MF $0.50 CSCL 09F

Progress is reported on the development of television S-band transmitters. The first transmitter has been completed. At the present time, the unit contains the power supply, amplifier tube, filters, and all circuitry except for the times 8 multiplier. All subsections of the transmitter were individually tested, both on the bench and under varying temperature conditions. All portions of the transmitter operated satisfactorily with the exception of the times 8 multiplier. The video amplifier was also completed and tested. The video bandwidth is approximately 30 Mc as compared with the 8 Mc required. It is concluded that the equipment will meet specifications. Further, it is considered that the frequency of the transmitter should be lowered to the more common television band of 1710 Mc for future missions. Such a change would simplify some of the current problems. E.E.B.

N66-13184# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

PRELIMINARY RESULTS OF PHASE QUADRATURE COMPONENTS OF MICROWAVE FORWARD SCATTERING FROM RANDOM WATER WAVES

C. I. Beard Jun. 1965 95 p refs

(DI-82-0440; AD-621718)

A system is described for measuring the statistics of the phase quadrature components of the microwave field forward (or bistatically) scattered from random water waves. Information on the phase quadrature statistics of the incoherent scattered field is of aid to theoretical treatments and of application to over-water communication, radar, missile guidance, etc. Two types of simple random wave generators are described which produce approximately Gaussian water height fluctuations in the wave channel, which is 22 ft. long, 3.5 ft. wide, and 1.5 ft. deep. TAB

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-12155*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ERROR ANALYSIS OF BINARY RATE MULTIPLIER

George J. Moshos Washington, NASA, Dec. 1965 34 p refs

(NASA-TN-D-3124) CFSTI: HC $2.00/MF $0.50 CSCL 09B

The binary rate multiplier is studied as a means of achieving approximate multiplication. The difference between the actual and desired output is defined as the error of the binary rate multiplier, and closed formulas are obtained for expressing this error in explicit form depending on the starting conditions ot the binary rate multiplier counter. As a result of analyzing these error formulas, error bounds are obtained. Author

N66-12181# Princeton Univ., N. J. Plasma Physics Lab.

A HIGH-SPEED DATA ACQUISITION SYSTEM

F. K. Bennett and C. G. Klotz [1965] 13 p Presented at the 1965 Symp. on Engr. Probl. of Controlled Thermonuclear Res., Livermore, Calif., 4–7 May, 1965

(Contract AT(30-1)-1238)

In designing a high speed data acquisition system for the C stellarator, consideration was given to obtaining maximum signal bandwidth, ease of operation, data display after the experiment, multiple inputs, data utilization by the IBM 1410 or 7094, and cost. The resulting system consisted of a 16-channel multiplexer, an analog-to-digital converter, coincident-current core storage, 556 bits/inch digital tape recorder, digital-to-analog converter and oscilloscope, and the associated timing and control unit. Each channel is sampled every 20 μsec, giving a maximum data collection rate of one sample every 1.25 μsec. The sampled signal is sent to the analog-to-digital converter where the analog signal is converted into an 8-bit parallel binary word, then sent to the memory and stored. After 4096 words are stored (taking approximately 5 msec), they are transferred to magnetic tape. Two display modes are available: channel display, and time slice display. Short subroutines were written to convert data into Fortran programs for the IBM 1410 and 7094 computers. M.G.J.

N66-12216* National Aeronautics and Space Administration, Washington, D. C.

A MATRIX COMPUTER FOR CALCULATING THE CORRELATION FUNCTION

O. V. Ulin and V. K. Petunin *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 98–104 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

A matrix computer is designed to automatically give numerical values for the correlation of continuous functions or for functions which are assigned by a series of discrete values. Block and schematic diagrams are included for this semiautomatic correlator which can be used with simplicity and reliability. Its multiplication matrix uses ferrite cores with square loop characteristics; and the current pulses serve to saturate one of the selected cores of the matrix network. Biasing winding provides current in the cores which is used to reverse the magnetism into the zero state. Details are given for the operation of the correlator which consists of a keyboard and a computer. Computer elements, constructed as individual units, include the multiplification matrix, blocking generators, registers, and amplifiers. When results with the correlator are compared with manual calculations for the first eleven values of a correlation function, the maximum relative error does not exceed five per cent. M.W.R.

N66-12286# Michigan Univ., Ann Arbor. Information Systems Lab.

AN ANALYSIS OF ERROR IN FINITE AUTOMATA

Philip S. Dauber Apr. 1965 18 p refs. *Its* Rept.-06920-1-T (Contract AF 30(602)-3546)

(ISL-65-1; AD-621972)

Errors in finite automata are studied. An error is defined as a pair of states and errors are then classified according to their probability of being corrected (i.e., being taken into the same state). Various results are then given on the partitioning properties of a particular type of error called a finite error.

Author (TAB)

N66-12333# Naval Postgraduate School, Monterey, Calif.

AN EXPERIMENTAL STUDY OF THE USES OF TERNARY LOGIC IN DIGITAL COMPUTERS

Richard D. Friichtenicht (M.S. Thesis) 1964 100 p refs

(AD-621976)

Digital computers presently in production are all binary logic machines, in that they are built with elements that have two stable states. Greater efficiency in computer speed and hardware would be obtained if elements with other than two states were used. Attempts are now in progress to find devices that have this property. The next logical step beyond binary would be ternary. A study of ternary algebras is made with emphasis on computer applications. Functional completeness and expansion theorems are introduced to show their usefulness in computer design. An adder circuit using three-level logic is described and a measure of effectiveness using cost

and complexity as criteria is made. It can be predicated that, as the binary computer approaches its ultimate in speed, more attention will be placed on N-valued logic machines.
Author (TAB)

N66-12356# Measurement Analysis Corp., Los Angeles, Calif.
SYSTEMS FOR THE COLLECTION AND ANALYSIS OF DYNAMIC DATA
Ronald D. Kelly Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1965 95 p refs
(Contract AF 33(615)-1314)
(MAC-402-05A; AFFDL-TR-65-94; AD-621909)

The machine errors are discussed of equipment used for the conditioning, collection, recording, editing, and analysis of data from dynamic processes such as acoustics, strain, or vibration. The specific equipment items studied include special features of signal conditioners (e.g., automatic gain control), signal conditioner to tape recorder transmission line, magnetic tape recorders, gross analyzers (e.g., voltmeters), frequency analyzers, amplitude analyzers, and time domain analyzers. (The machine errors associated with transducers and basic signal conditioners are presented in 'Transducers for Sonic Fatigue Measurements.') Where these errors are controllable, such as the smoothing error associated with the rate of scanning an amplitude window for probability density measurements, pertinent equations are presented for determining the magnitude of these errors as a function of the controllable parameter(s). In addition, the report describes practical usage of the analysis equipment for the detection of non-normality, non-stationarity, and periodicity. Author (TAB)

N66-12409* Maryland Univ., College Park. Computer Science Center.
COMPUTER-ORIENTED RESEARCH IN THE SPACE-RELATED SCIENCES AT THE UNIVERSITY OF MARYLAND
Werner C. Rheinboldt *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 22 p refs (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00
(Grant NsG-398)

The program is aimed at stimulating and broadening the effective use of computers in the University's space related efforts and at investigating new methods of computer application in these fields. Personnel and equipment at the Center are discussed and the main programming system is described. The in situ probe system for the measurement of ionospheric parameters and the extensive experimental and theoretical research study concerning rotating laboratory models which simulate the general circulation of the atmosphere are discussed in detail. E.E.B.

N66-12440# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).
A PROCEDURE FOR COMPUTING OF NORMALIZED SPACE-TIME-CORRELATION-FUNCTIONS OF AERO-ACOUSTIC SIGNALS [EIN VERFAHREN ZUR BERECHNUNG NORMIERTER RAUM-ZEIT-KORRELATIONS FUNKTIONEN AERO-AKUSTISCHER SIGNALE]
R. Schneider and H. Dahlen Jun. 1965 35 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-37) CFSTI: HC $2.00/MF $0.50

A correlator is described, which computes normalized space-time-correlation functions of aero-acoustic signals. It consists mainly of a fast analogue computer and a time delay. It is compared with other kinds of correlators. The performance is demonstrated with examples of some measured characteristic auto- and space-time cross-correlation functions. Author

N66-12523# Communication Systems, Inc., Falls Church, Va.
ANALYSIS AND SIMULATION OF ADVANCED DCS SWITCHES: DCS AUTOVON SIMULATOR Final Report
31 Aug. 1965 323 p refs
(Contract AF 19(628)-3414)
(WCSI-65-TR-1008; AD-621934)

The report summarizes the development of the AUTOVON Simulator and provides all information necessary for its use. Programmed for the Philco 2000 computer, this simulation tool is now in daily use at DCA for communication systems management and design evaluation. The AUTOVON (Automatic Voice Network) Simulator is a highly detailed computer model designed to provide quantitative measures of system performance resulting from proposed changes in traffic, routing, or configuration. TAB

N66-12548# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical Engineering.
REPRESENTATION AND ANALYSIS OF SIGNALS. PART XIX: DIGITAL COMPUTER PROGRAMS FOR SIGNAL ANALYSIS
Garrett M. Odell and Robert N. Mc Donough 1 Aug. 1965 123 p
(Contract Nonr-4010(13))
(AD-619439)

This report describes a collection of digital computer subroutines which perform many operations useful in the linear analysis of single epoch signals and linear, stationary, stable systems. Of central importance is the process of expressing a signal as a linear combination of a set of real and/or complex, decaying, exponential functions, which may or may not be orthonormalized. The subroutine descriptions are designed to allow a person who is well acquainted with the concepts and calculations involved in signal analysis, but who has only a working knowledge of the FORTRAN computing language, to assemble various subroutines into useful composite programs. To this end, brief numerical examples are included for each subroutine to illustrate precisely how the input arguments define a given problem, and how the output arguments supply its solution. In addition to subroutines intended specifically for signal analysis, subroutines which perform common algebraic calculations and convenient input-output operations are included. Author (TAB)

N66-12567# Control Data Corp., Minneapolis, Minn.
HYBRID COMPUTER STUDY Final Development Report, 1 Sep. 1964–1 Jul. 1965
31 Jul. 1965 362 p refs
(Contract NObsr-93003)
(GO3242; AD-620911)

The results are presented of a study conducted for the purpose of determining design requirements and operational philosophies for a hybrid data processing system in a real-time shipboard automation and control system utilizing an optimum combination of digital and analog techniques. The following investigations were included: automation tasks, hybrid simulation techniques, approaches to integrating digital and analog processing, microelectronic circuits and packaging available at present and in the future, and functional separability of the digital portion of the system for general purpose data processing. The recommended system would monitor and control ship's power plant and would organize, summarize, and display operational information to the commander. Pertinent design criteria of the hybrid system are described, with particular attention to the hardware and software provisions for priority multilevel interrupts and task execution priority selection, to the remote display and data entry units, and to the computer logic circuitry and standard NAFI packaging. Microelectronics

(integrated circuits) should be employed using NOT-AND/OR circuits of the Transistor–Transistor Logic type. Author (TAB)

N66-12584# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MIDAS COMPUTATION OF WATERDROP EVAPORATION
R. J. Engelmann Jul. 1965 38 p refs
(Contract AT(45-1)-1830)
(BNWL-74) CFSTI: $2.00

This paper explains MIDAS program for IBM 7090 machine computation of evaporation of waterdrops falling through varying temperature and humidity profiles. Because of its simplicity, MIDAS programming (similar to analog programming) can be quickly learned. Author

N66-12619# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADIOMETER DATA PROCESSING IN THE HAYSTACK ANTENNA POINTING SYSTEM
Paul Stylos 29 Jul. 1965 62 p *Its* TN-1965-14
(Contract AF 19(628)-5167)
(ESD-TDR-65-314; AD-620872)

Since Radiometric methods are used to boresight the Haystack System, the Univac 490 antenna pointing system includes a radiometer data processing program which operates in real time concurrently with the antenna pointing programs. The main input to the program is comprised of 30-bit data words passed from the radiometric equipment to the computer via channel 5. Each word contains identification bits allowing the computer program to distinguish between two different types of data: 'auxiliary' or 'radiometric'. The processing of the auxiliary data consists of a simple check to determine if data associated with a particular identification falls within specified bounds for that identification. This data is then logged on the highspeed printer, along with its associated upper and lower limits, and an indication if the data is outside of the specified limits. Processing of the radiometer data is more complex; in general, the primary output is a running measure of radiometric source temperature. The results of this processing are both logged and plotted on the high-speed printer in real time. TAB

N66-12712 Joint Publications Research Service, Washington, D. C.
STARTING SPEED SELECTION OF MOTORS WITH NONLINEAR MECHANICAL CHARACTERISTICS IN AUTOMATION SYSTEMS
N. P. Zakaznov *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 60–68 ref (See N66-12701 03-14) CFSTI: $5.00

The article considers a device which combines the functions of a decoder and corrector of a cyclic code. The device is arranged to correct erasure errors and detect conversion errors in the erasure channel. Author

N66-12713 Joint Publications Research Service, Washington, D. C
ROUNDING DECIMAL FRACTIONS ON BINARY DIGITAL COMPUTERS
F. Ya. Galkin *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 79–85 refs (See N66-12701 03-14) CFSTI: $5.00

The article proves the possibility of rounding decimal fractions on digital computers (ETsVM) which operate in the binary system. The conclusions are confirmed by concrete examples. Several constants used in rounding are cited. Author

N66-12714 Joint Publications Research Service, Washington, D. C.
SOLUTION OF INTEGRAL EQUATIONS WITH THE AID OF SIMULATION MODELS
S. A. Ponyrko *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 86–93 refs (See N66-12701 03-14) CFSTI: $5.00

The article describes a method for designing simulating devices for the solution of linear integral equations. Author

N66-12778# New York Univ., N. Y. Lab. for Electroscience Research.
A CRITERION FOR THE QUANTIZATION OF LINE-DRAWING DATA
Jeremy M. Glass May 1965 160 p refs Tech. Rept.-400-112
(Grants AF-AFOSR-24-64; AF-AFOSR-24-65)
(AFOSR-65-1495; AD-621086)

The digital transmission of line-drawing data requires that the data first be quantized. Since quantization tends to degrade the original data, it is desirable to employ as fine a quantization as possible. A criterion is developed for enabling one to determine the coarsest possible quantization that will preserve the original data to within a specified tolerance. In the criterion developed, line drawings are thought of as thin elastic beams, which can be characterized by means of their strain-energy density functions. Quantization is seen to result in a spreading of these density functions, creating an uncertainty region in an energy space, the uncertainty decreasing with finer quantization. Of the possible continuous reconstructions that can be generated from the quantized data, there is one that is of particular interest—the minimum-energy curve. An appropriate quantization is determined by requiring that the total energies of the minimum-energy curve and the original curve be within a specified tolerance. TAB

N66-12781# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTERS IN AUTOMATIC SYSTEMS
A. A. Fel'dbaum 12 Aug. 1965 22 p Transl. into ENGLISH from Vychislitel'nyye Ustroystva v Avtomat. (USSR), 1959 p 367–376
(FTD-TT-65-618/1+2+4; AD-620858)

A digital differential analyzer working in double numeration is discussed. TAB

N66-12798# Naval Research Lab., Washington, D. C.
IFF ACTIVE READOUT CONTROL AND DISPLAY SYSTEM
F. R. Fluhr 3 Sep. 1965 19 p refs
(NRL-6277; AD-622117)

An IFF active readout control and display system using majority logic and PPI position correlation techniques is being developed in the Data Processing Branch. Up to five target responses in each interrogated mode are stored, and majority-voting logic determines the confidence of the stored returns in each mode. So long as a gated target's interrogation responses are present during one scan, the numerical processing continually attempts to increase the confidence of the stored returns. The position correlation techniques point out the location of the responding target on the PPI. A true range and azimuth video gate technique, which can work with analog or digital PPI sweeps, has been devised. This video gate technique works in conjunction with the PPI retrace insertion method employed. Author (TAB)

N66-12820# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A PERMANENT-MEMORY DEVICE USING RESISTORS
A. Ya. Shpil'berg, V. R. Petrov, and V. I. August 20 Sep. 1965 6 p Transl. into ENGLISH from Soviet Patent No. 161576 (Appl. no. 821532/26-24, 25 Feb. 1963) 1 p
(FTD-TT-65-513/1+2+4; AD-621178)

Permanent-memory devices are known based on resistors which are designed in the form of matrices from mutually perpendicular address and charge bars at the cross points of which there are located resistors with the same devices on the passive elements with the recording of zero by means of supplying of voltage onto the respective vertical and horizontal for the elimination of connection between these bars. The device is distinguished from the known ones by the fact that for the different time delay of the signals of unity and zero to their address and digit bars condensers are connected in.
Author (TAB)

N66-12822# California Univ., Berkeley. Operations Research Center.
DECOMPOSITION AND INTERCONNECTED SYSTEMS IN MATHEMATICAL PROGRAMMING
Paul Rech Sep. 1965 90 p refs
(Contracts Nonr-222(83); DA-31-124-ARO-D-331; Grant NSF-GP-4593)
(ORC-65-31; AD-622501)

This thesis is concerned with the development of a decomposition method for solving large linear programming problems arising from N interconnected systems. TAB

N66-12823# Illinois Univ., Urbana. Coordinated Science Lab.
A CURRENT MODE DA CONVERTER
Jack Stifle Aug. 1965 36 p
(Contract DA-28-043-AMC-00073(E))
(R-263; AD-619778)

The design of a digital to analog converter using a current driven ladder instead of the more conventional voltage driven technique is described. The constant current source is a standard Darlington configuration which is easily temperature compensated. The converter specifications include a maximum worst case absolute error of less than .01%, long term stability better than .008%, 0 offset voltage, and a setting time of less than 1.8 microsec. No trimming components are used.
Author (TAB)

N66-12847# Naval Research Lab., Washington, D. C.
OPERATION AND PERFORMANCE OF THE NRL SATELLITE POSITION DISPLAY
H. G. Talmadge, Jr., and R. J. Orsino 11 Aug. 1965 29 p refs
(NRL-6219; AD-622198)

Nearing completion at NRL is an experimental Satellite Position Prediction and Display equipment (SPAD) for shipboard use. SPAD will store orbital elements and related information of 88 satellites in a digital computer, which then will predict and display positions and other information on up to eleven satellites. Position and height information is updated on the 19-in. geographic display each 1.0 sec. The prediction time can be varied forwards or backwards to permit a rapid determination of where and when different configurations of satellite orbits, for instance, satellite grouping, will occur. An orbit with a granularity of four degrees in both latitude and longitude can be computed in just five seconds. The operational program, prepared for the AN/UYK-1 digital computer, takes into account the variation of anomalistic periods of irregular satellites. Thus, positions of decaying satellites have been printed on the tabular readout with position errors of as much as 0.2 deg in latitude or longitude at nine days from epoch. A surveillance circle up to 504 naut mi in radius for one selected satellite can be painted on the expanded display. Course, speed, and position of own ship are displayed at all times.
Author (TAB)

N66-12880# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE COMPUTATION PROBLEM WITH SEQUENTIAL DECODING
John E. Savage 16 Feb. 1965 78 p refs *Its* Tech. Rept.-371
(Contract AF 19(628)-500)
(ESD-TDR-65-52; AD-621713)

Fano Sequential Decoding is a technique for communicating at a high information rate and with a high reliability over a large class of channels. However, equipment cost and variation in the time required to decode successive transmitted digits limit its use. This work is concerned with the latter limitation. Others have shown that the average processing time per decoded digit is small if the information rate of the source is less than a rate R-comp. This report studies the probability distribution of the processing time random variable and applies the results to the buffer overflow probability, i.e., the probability that the decoding delay forces incoming data to fill and overflow a finite buffer. It is shown that the overflow probability is relatively insensitive to the buffer storage capacity and to the computational speed of the decoder, but quite sensitive to information rate. In particular, halving the source rate more than squares the overflow probability. These sensitivities are found to be basic Sequential Decoding and arise because the computation per decoded digit is large during an interval of high channel noise and grows exponentially with the length of such an interval. A conjecture is presented concerning exact behavior of the overflow probability with information rate. This conjecture agrees well with the (limited) experimental evidence available.
Author (TAB)

N66-12881# Research Analysis Corp., McLean, Va.
COMPUTER PROGRAM IMPLEMENTING THE SEQUENTIAL UNCONSTRAINED MINIMIZATION TECHNIQUE FOR NONLINEAR PROGRAMMING
Garth P. McCormick, W. Charles Mylander III, and Anthony V. Fiacco Apr. 1965 92 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-151; AD-621991)

The mathematic programming problem-minimize f(x) subject to $R_j(x) > \text{or} = 0$ for $j = 1, \ldots, m$, where f and the R_j's may be nonlinear is solved by solving a sequence of unconstrained minimization problems. Upper and lower bounds on the optimal solution value, primal and dual feasible points, and estimates of the optimal solution values are generated after each iteration. The program is coded in Fortran IV.
Author (TAB)

N66-12883# System Development Corp., Santa Monica, Calif.
ENGINEERING MATHEMATICS VIA COMPUTERS
John Staudhammer 11 Aug. 1965 25 p refs
(SP-2176/000/00; AD-622008)

The need for extensive efficient use of computers in the engineering curriculum is discussed. An approach is outlined that demonstrably can enhance the understanding of engineering mathematics. The content of, and some of the mechanics of, teaching a course with extensive machine help is described. Results of several offerings of the course are presented.
Author (TAB)

N66-12886# System Development Corp., Santa Monica, Calif.
AN EMPIRICAL INVESTIGATION INTO THE BEHAVIOR OF THE SDC TIME-SHARING SYSTEM

Robert A. Totschek 27 Aug. 1965 79 p refs
(Contract ARPA SD-97)
(SP-2191/000/00; AD-622003)

The behavior of a computer time-sharing system is intrinsically complex because such a system effects a compromise between allowing jobs to run to completion and allowing its several users simultaneous complete and immediate access to operate and debug their programs. It is generally known that computer systems that allow jobs to run to completion tend to maximize system efficiency; computer systems that offer the individual the most immediate possible response tend to maximize their utility to the user. It is also known that the relatively slow speeds of the 1/10 devices that buffer individuals from computers (and vice versa) permit the time sharing systems to service several users at a reasonable cost per user. The report attempts to make more precise statements about the behavior of the SDC time-sharing system, using data obtained from 13 one-hour recordings. These data include distributions of service and interarrival times, number of users, and overhead times. In addition, two scheduling logics are compared. Several measures of effectiveness, from both a system and an individual viewpoint are introduced and evaluated using these data. Some analyses have also been included to predict the effects of system changes. Author (TAB)

N66-12892# Los Alamos Scientific Lab., N. Mex.
DTF-IV, A FORTRAN-IV PROGRAM FOR SOLVING THE MULTIGROUP TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING
K. D. Lathrop 12 Nov. 1965 143 p refs
(Contract W-7405-ENG-36)
(LA-3373) CFSTI: $4.00

The report describes the theory and the use of a code designed to solve, by the methods of discrete ordinates, the multigroup, one-dimensional (plane, cylinder, sphere) Boltzmann transport equation, including anisotropic scattering. Anisotropic scattering is represented by Legendre polynomial expansion of the differential scattering cross section which is truncated after ISCT + 1 terms. Complete (in energy) scattering transfer matrices are allowed for as many scattering expansion coefficients as are permitted by machine storage limitations. The report includes flow diagrams of the code, a code listing, and the results of a test problem. Author

N66-12936# Joint Publications Research Service, Washington, D. C.
A CONTRIBUTION TO THE THEORY OF ASYMMETRICAL CODES
R. R. Varshamov 19 Nov. 1965 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), 1965, v. 164, no. 4 p 757–760
(JPRS-32939; TT-65-33516) CFSTI: $1.00

This study attempts to penetrate deeper into the mathematical structure and the characteristic peculiarities of the asymmetric codes, and to establish the lower and upper bounds for the maximal possible number of signals in codes with correction of the asymmetrical errors. R.N.A.

N66-12963*# Maryland Univ., College Park. Computer Science Center.
PATTERN RECOGNITION. I: A COMPUTER PROGRAM FOR GENERATING SYNTHETIC PATTERNS
Nancy S. Anderson, Azriel Rosenfeld, and Norman F. Simenson Jun. 1964 74 p refs *Its* Tech. Rept.-64-8
(Grant NsG-398)
(NASA-CR-68300) CFSTI: HC $3.00/MF $0.75 CSCL 09B

This report is designed to serve as a user's description and guide to a general program for generating patterns of overstruck alphanumeric characters. The program philosophy and data preparation sections are intended to enable a user to prepare data for the generation of patterns appropriate to his particular needs. A sample set of patterns generated by this program and a brief description of the main program and subroutines intended for use by programmers for modification and/or extension are included. The program is written in FORTRAN II for use under IBSYS; it has been extensively tested on the 7090. Author

N66-13030# Joint Publications Research Service, Washington, D. C.
AUTOMATIC RECORDING AND TRANSMISSION INSTALLATION FOR METEOROLOGICAL DATA
G. Gerth and W. Hohne 1 Dec. 1965 18 p refs Transl. into ENGLISH from Z. Meteorol. (East Berlin), v. 18, no. 3–4, 1965 p 132–141
(JPRS-33101; TT-65-33678) CFSTI: $1.00

The authors list the requirement for automatic collection and transmission of meteorological data and discuss the problems of analog-digital conversion as well as the transmission and storage of information. They further describe a device making it possible to collect a number of meteorological data either continuously or intermittently in time which can be converted into digital quantities and coded for teleprinter transmission. The data transmitted are printed out directly in tabulated form and may be stored on punched tape for further processing. The device has been given a high degree of reliability through logical elements utilizing diode transistors instead of relays. Author

N66-13078*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
BIBLIOGRAPHY AND SUMMARY OF METHODS RELATED TO THE ERROR ANALYSIS OF HYBRID COMPUTERS
Thomas M. Wright, Jr. 14 Oct. 1964 23 p refs
(Contract NAS8-2473)
(NASA-CR-68405) CFSTI: HC $2.00/MF $0.50 CSCL 09B

A summary is presented of current methods used in attacking the error problems present in analog computers, sampled data systems, and hybrid computers. The survey indicates that the best approaches to error analysis of hybrid computers are probably the use of sensitivity coefficients based on a modification of the method of Miller and Murray, and the use of root shifting techniques in linear problems or problems which can be linearized. In both approaches, approximations for transfer functions of different components and the use of a variety of mathematical tools such as Z transforms will be helpful. An extensive bibliography is also included. R.N.A.

N66-13146# Joint Inst. for Nuclear Research, Dubna (USSR).
PROCESSING OF DATA OBTAINED WITH A SEMIAUTOMATIC DEVICE FOR SCANNING OF SPARK CHAMBER PHOTOGRAPHS [OBRABOTKA DANNYKH POLUCHENNYKH PRI POMOSHCHI POLUAVTOMATICHESKOGO PRIBORA DLYA PROSMOTRA SNIMKOV S ISKROVYKH KAMER]
I. Bystritskii, F. Leger, P. Libl, M. Maly, O. Sgon et al 1965 14 p refs in RUSSIAN
(JINR-P-2223) CFSTI: HC $1.00/MF $0.50

A method for processing the information obtained in track measurements on a semi-automatic device PIP-35 is treated. The preparation of the numerical material for further processing is described. Author (NSA)

N66-13202# Illinois Univ., Urbana. Coordinated Science Lab.
COMPUTER COMPILER. PART I: PRELIMINARY REPORT

G. Metze and S. Seshu Aug. 1965 38 p
(Contract DA-28-043-AMC-00073(E); Grant NSF GK-36)
(R-264; AD-619738)

A technique is proposed for the automatic system design of a digital computer. The desired computer is described in a FORTRAN-like language. This information is read by a (system) compiler which produces a micro-instruction flow-chart optimized according to the given criterion. This output is given to another (logic) compiler which produces the logic circuit diagram of the desired machine. The basic concepts and the proposed input language are discussed in this preliminary report and an example of the input for a full-fledged computer is given.
Author (TAB)

N66-13248# Argonne National Lab., Ill.
COLLECTED ALGORITHMS 1960–1963 FROM THE COMMUNICATIONS OF THE ASSOCIATION FOR COMPUTING MACHINERY
R. E. Grench and H. C. Thacher, Jr., ed. Jul. 1965 167 p refs
(Contract W-31-109-ENG-38)
(ANL-7054) CFSTI: $5.00

A tabulation is presented of the first 220 algorithms published in the Communications of the Association for Computing Machinery. The algorithms are written in ALGOL, and a tutorial description of the language is given. The volume includes two indexes: one by general subject, and one by author. In the first the algorithms are arranged according to a modification of the SHARE classification. This classification includes the task to be accomplished, and a reference to this index gives the number and descriptive titles of algorithms in this area. Comments are given for each algorithm and includes a statement of what the algorithm accomplishes and a general description of the method used, often with a reference to a more extended discussion. Certifications (results of tests of the algorithm) and remarks follow each algorithm.
C.T.C.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-12186*# Pennsylvania State Univ., University Park. Systems and Controls Lab.
[RESEARCH AND DEVELOPMENT OF ON BOARD CONTROL SYSTEMS AND ELEMENTS FOR AEROSPACE VEHICLES] Research Report No. 2
J. C. Tamulis et al Oct. 1965 14 p refs
(Grant NGR-39-009-023)
(NASA-CR-68101) CFSTI: HC $1.00/MF $0.50 CSCL 09F

The following studies are reported: (1) *Signal Noise in Fluid Amplifiers*—large scale fluid amplifier, free jet apparatus, associated measuring and recording devices, and analytical and theoritical studies of proportional pure fluid pressure amplifiers; (2) *Pneumatic Stepping Motor*—initial development tests of prototype pneumatic motor; (3) *Hydraulic Stepping Motor*—analog computer studies of changes in geometry, mass, and power requirements; (4) *Experimental Electric Servomotor*—design configuration of high performance D-C motor; (5) *Hysteretic Nonlinearities in Closed Loop System*—development of switching logic to eliminate instability; (6) *Dynamics of Fluid Transmission Lines*—frequency estimation by using models of the matrix transfer function, and of a linear lumped parameter using electrical network theory; (7) *Some Unusual Analog Computer Circuits*—circuits for spatial integration, etc.; (8) *Steam-To-Air Energy Converter*—free piston concept; and (9) *Fluid Amplifier Pressure Sensor*—analytical modeling of devices for incorporation into engineering systems.
G.G.

N66-12319# Westinghouse Electric Corp., Philadelphia, Pa.
PRODUCTION ENGINEERING MEASURE TYPE 2N2762 SILICON ALLOY TRANSISTOR Quarterly Progress Report, 1 Apr.–30 Jun. 1965
R. J. Pisarcik and J. E. Priest [1965] 14 p
(Contract DA-36-039-AMC-03617(E))
(QPR-8; AD-621856)

All process improvements are noted as completed and incorporated in the contract device. The status and yield data are presented for the production run. Additional data are presented for the step stress program for the reliability test program. A modification, to provide more accurate control of starting material, is described for the evaluation of silicon wafers.
Author (TAB)

N66-12325# Weston Instruments Inc., Newark, N. J.
A POROUS SUBSTRATE RESISTOR AIMED AT MINIATURIZATION OF METAL-FILM RESISTORS Interim Development Report, 1 Mar.–31 May 1965
T. Matley and P. M. Gross [1965] 16 p
(Contract NObsr-87542)
(IDR-11; AD-621748)

A new method of soldering a terminal onto the porous substrate was attempted with encouraging results. This terminating method allows the metallizing to be performed prior to termination. The advantage is that better solution penetration during metallizing results if the surface of the substrate is not masked by terminals. A new cylindrical shaped substrate was successfully tried as a replacement for the old style. The new substrate measures 0.25' in diameter and 0.40' in length as compared to the old style that measures 0.30' × 0.30' × 0.40'. The new shape substrate is molded of the same material as the old style (Filtros, Inc., Type K).
Author (TAB)

N66-12332# Naval Postgraduate School, Monterey, Calif.
ELECTRONICALLY SCANNED ANTENNAFIER USING TUNNEL DIODES AND VARACTOR PHASE SHIFTERS
John F. Kropf (M.S. Thesis) 1964 83 p refs
(AD-621977)

The electronic scanning antenna array has many advantages over the conventional antenna system. This thesis proposes the marriage of a low noise tunnel diode amplifier and varactor phase shifter at the antenna to scan and amplify. A different method of tuning varactor phase shifters is proposed, along with a simple method of designing tunnel diode amplifiers using the Smith Chart for determining design parameters. The final design consists of a two element sample array using four tunnel diodes and two varactors in a strip-line circuit directly behind an S-band spiral antenna.
Author (TAB)

N66-12334# Research Triangle Inst., Durham, N. C. Solid State Lab.
DESIGN PARAMETERS AND PROCEDURES FOR FUNCTIONAL ELECTRONIC STRUCTURES Technical Report, Jul. 1964–Jun. 1965
Sep. 1965 229 p refs
(Contract AF 33(615)-1998)
(AFAL-TR-65-234; AD-469962)

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6. SMALL SIGNAL PROPERTIES OF FIELD EFFECT DEVICES J. R. Hauser p 63–116 refs (See N66-12336 03-09)
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9. IMPURITY DIFFUSION IN SILICON A. M. Smith and R. P. Donovan p 165–181 refs (See N66-12339 03-06)
10. FORMATION AND PROPERTIES OF OXIDES ON SILICON R. P. Donovan p 183–205 refs (See N66-12340 03-06)
11. SILICON INTEGRATED DEVICE THEORY R. M. Burger and J. R. Hauser p 207–218 refs (See N66-12341 03-26)

N66-12335 Research Triangle Inst., Durham, N. C. Solid State Lab.

CURRENT SATURATION PHENOMENA IN JUNCTION FIELD EFFECT DEVICES

J. R. Hauser *In its* Design Parameters and Procedures for Functional Electron. Struct. Sep. 1965 p 25–61 refs Submitted for Publication (See N66-12334 03-09)

Several aspects of drain current saturation phenomena are considered in junction field effect devices. A proposed mathematical model is an extension of Shockley's formulation of saturation theory and includes the spreading of the depletion region beyond the physical ends of the gate junctions toward the drain contact. Solutions are given for specific values of channel length-to-width ratios between four and one. Complete pinch-off of the channel never occurs at current saturation. In junction field effect devices with small length-to-width ratios, saturation current and transconductance can be greatly reduced because of velocity saturation of the charge carriers at the drain end. When the ratio is four or greater, velocity saturation has a negligible effect on the terminal.

M.W.R.

N66-12336 Research Triangle Inst., Durham, N. C. Solid State Lab.

SMALL SIGNAL PROPERTIES OF FIELD EFFECT DEVICES

J. R. Hauser *In its* Design Parameters and Procedures for Functional Electron. Struct. Sep. 1965 p 62–116 refs Submitted for Publication (See N66-12334 03-09)

Nonlinear partial differential equations are obtained for the current and voltage along the channel of field effect devices. Small signal equations for the terminal currents are solved by an iterative technique, which results in a power series of the frequency. The equations given are also applicable to the solution of problems in RC transmission lines with voltage dependent resistance and capacitance. Admittance parameters and equivalent circuits are discussed, and characteristic frequencies are evaluated for specific types of field effect devices. Devices considered include those with both gates connected together, one gate connected to the source, and dual gate control with source grounded. Junction and MOS (metal-oxide-semiconductor) field effect devices are discussed in conjunction with the mathematical model. Parasitic elements, which arise because of lead capacitance as well as differences between the model and practical devices, are mentioned. M.W.R.

N66-12362# Westinghouse Electric Corp., Baltimore, Md. Surface Div.

STUDY OF MICROCIRCUITRY TECHNIQUES UTILIZING MOLECULAR ENGINEERING Final Report

[1965] 86 p

(Contract NObsr-81380)

(MDE-5513; AD-621371)

The major accomplishments of the contract program were: (1) An extensive study of molecular techniques for the fabrication of X and Y-amplifiers for peripheral driver circuitry of solid state display systems. (2) The development of a planar all-diffused process used in the final amplifier fabrication which accomplished all of the requirements of satisfactory process control, yield, suitability for mass production and economy, as well as the obvious requirements of meeting electrical specifications. (3) The design and development of a unique, switch-field effect resitor circuit which simplified thermal considerations, allowed higher density packaging, and reduced power supply requirements. (4) Development of a high density packaging scheme allowing 16 amplifiers to be packaged in one linear inch modules which could be stacked end to end in an actual display system environment. The final phase of the program was concerned with an investigation of possible additional applications of the pulse amplifier, or a modification of the amplifier, to NIXIE driver requirements. It was concluded that the pulse amplifier is capable of driving minature NIXIE tubes having current requirements on the order of one milliampere. Furthermore, a slightly modified pulse amplifier was developed which is capable of driving the complete line of NIXIE tubes and alpha-numerics and is compatible with monolithic microcircuit fabrication techniques. TAB

N66-12446# Sperry Microwave Electronics Co., Clearwater, Fla.

DEVELOPMENT OF C-BAND FERRITE DUPLEXER Final Report, 1 Nov. 1963–15 May 1965

J. E. Andrews and J. L. Brediger [1965] 100 p refs *Its* Rept.-4

(Contract DA-36-39-AMC-03394(E))

(SJ-M-212-0049-4; AD-621915)

The development of a C band, all solid state radar front end utilizing high quality state-of-the-art ferrite devices, completely passive in nature, and serving as a (fail-safe) duplexer-limited with the option of frequency preselection is presented. The duplexers consist of a 4 port singlejunction circulator and associated limiters. The ferrite limiter assembly is made up of a waveguide subsidiary resonance limiter with a dual-sphere, broadband, gyromagnetic coupling limiter or a single-sphere, narrow band, gyromagnetic coupling limiter and a varactor cleanup limiter. The theory and development of the circulator and limiter are discussed in detail. The circulator consists of ferrimagnetic disks placed at the center of a coplanar 90 degrees, WR187 waveguide junction. The ferrimagnetic disks are biased close to resonance and support circulation to one adjacent port while isolating all others. The dualsphere limiter is constructed in strip transmission line and utilizes both first and second order limiting processes to obtain the desired dynamic range and low level limiting threshold. Gyromagnetic coupling techniques and modern network synthesis have been employed to obtain the instantaneous bandwidth of greater than 10 percent. Final high power and low power test results are reported and analyzed.

Author (TAB)

N66-12472# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.

A NUMERICAL REPRESENTATION OF CCIR REPORT 322 HIGH FREQUENCY (3-30 MC/S) ATMOSPHERIC RADIO NOISE DATA

Donald L. Lucas and John D. Harper, Jr. 5 Aug. 1965 105 p refs

(NBS-TN-318) GPO: $0.55

Geographic and frequency dependent distributions of atmospheric noise power are approximated by series expansions for use in electronic computers. Coefficients of Fourier series representation of worldwide geographic dependence and power series representation of both mean and decile variability of the frequency dependence are tabulated. Representative contour charts of all distributions are shown along with sample longitudinal and latitudinal variations. Author

N66-12477# General Electric Co., Syracuse, N. Y. Electronics Lab.

HIGH-FREQUENCY ANALYSIS OF SHUNT-SERIES FEEDBACK AMPLIFIER

G. B. Gawler Jun. 1965 5 p

(R65ELS46)

The shunt output series-input transistor feedback amplifier has often been used for low-frequency work. This report outlines an analysis for determining the bandwidth attainable with high-frequency transistors in this feedback configuration. For this purpose, the Giocoletto pi and high frequency T-equivalent circuits will be discussed, and the analysis will then be based on these equivalent circuits. Author

N66-12505# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENERATOR OF PERIODIC SEQUENCE OF BUNDLES OF SQUARE PULSES

Yu. A. Leybman 3 Jun. 1965 8 p Transl. into ENGLISH from Soviet Patent no. 156185 (Appl. no. 722800/26, 23 Mar. 1962) 4 p

(FTD-TT-65-177/1+2; AD-620122)

The object of the invention is a generator of periodic sequence of bundles of square pulses with regulatable length and intervals between them which contains a master generator connected up to a conversion system controlling a shaping trigger and a feedback circuit which serves for dropping (throwing out) the count. For the purpose of shaping a series of pulses with mutually independent length of the pulses and the intervals between them issuing into one or several channels, and the simplification of the distribution of the pulses over the channels, in it there is used a commutating register and pairs of systems of matching connected up to it the number of which is equal to the number of independently regulatable pulses and intervals between them, with the outputs of each pair of systems of matchings connected up through systems 'ILI' to one shaping trigger, and in the distribution of the pulses over the different channels the outputs of each pair of systems of matchings are connected up to separate shaping triggers. Author (TAB)

N66-12513# Clevite Corp., Cleveland, Ohio. Electronic Research Div.

RESEARCH INTO NEW APPROACHES FOR VHF FILTER CRYSTALS Eighth Quarterly Report, 16 Apr.–15 Jul. 1965

D. J. Koneval and D. R. Curran 18 Aug. 1965 24 p refs

(Contract DA-36-039-AMC-02245(E))

(Rept.-8; AD-621727)

Experiments in which resonator Q_m is observed as a function of electrode length were continued in an attempt to correlate these data with the theoretical results obtained by Professor R. D. Mindlin from a consideration of intermode coupling. Results to date have been inconclusive. Initial attempts to fabricate 90 Mc, 5th harmonic mode inverted mesa resonators using deposited films indicated that substantial improvement in techniques for alignment between resonator electrodes and the deposited dielectric layer would be required. A non-optical method of determining the parallelism of quartz blanks was investigated. Air-gap frequency measurements yielded a qualitative measure of the parallelism of quartz blanks. Refinements of this technique should provide a more precise measurement of blanks having a thickness variation of less than half wavelength. Author (TAB)

N66-12517# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.

PRODUCTION ENGINEERING MEASURE (PEM) FOR TRANSISTOR, PNP, SILICON, SWITCHING TYPE EL-2N(X-12) First Quarterly Progress Report, 25 Mar.–25 Jun. 1965

Larry G. Lands [1965] 73 p refs

(Contract DA-36-039-AMC-06160(E))

(TI-03-65-69; AD-621873)

The developmental geometry was modified from a stripe emitter to a circle emitter. Device geometry was made smaller and greater versatility was achieved. Initial material resistivity produced adequate breakdowns when epitaxial film thickness exceeded 0.20 mil. However, initial device runs were characterized by high $V_{(CE\ (sat))}$, low h_{FE} and absolute value (h_{fe}). The fall off of h_{FE} at low voltages and 10 milliamperes collector current was primarily due to the high $V_{(CE\ (sat))}$. Plots of h_{FE} and absolute value (h_{fe}) vs. collector current indicated the peak point of operation was approximately one milliampere. Switching times reflected these problems in long rise and fall times. The parasitic capacitances of the device package and the switching jig prevented a delay time of three nanoseconds. Gold diffusion was successful in attaining storage times below nine nanoseconds. Leakage currents were not appreciably affected by gold diffusion.

Author (TAB)

N66-12519# Collins Radio Co., Dallas, Tex.

RESEARCH AND DEVELOPMENT INVESTIGATION OF A PRECISION DIGITAL FREQUENCY SYNTHESIZER FOR SSB Quarterly Report No. 3, 1 Jan.–30 Apr. 1965

T. C. Thomas 12 Aug. 1965 35 p

(Contract DA-28-043-AMC-00176(E))

(IDR-D577-3; AD-621033)

The digital circuits that have been built and tested have shown satisfactory performance over the required environmental conditions and have operated near or below the power dissipation estimates made earlier in the design. The digital circuits are capable of being packaged in miniature high density packages. Considering present developed techniques, the thin-film approach is the most promising to achieve the performance at the power dissipations of the developed digital circuits. The phase comparator/low-pass filter is the major problem toward achieving a spurious level goal of 90 db. A 70-db spurious level is more realistic. The configuration of this area requires considerably more work for a conclusion. The multioscillator approach (15 to cover the 2- to 33-mc band) is becoming more feasible. The output combining circuits have presented no problems. The power dissipation is in the order of earlier goals. The problem with this approach is the future miniature packaging. The configuration is foreseen as a hybrid thin-film circuit. Sufficient progress has not been made in the output circuits to draw conclusions. Author (TAB)

N66-12547# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
HIGH SPEED SEMICONDUCTOR SWITCH (TWO TERMINAL) AND HIGH SPEED SEMICONDUCTOR SWITCH (GATE), PRODUCTION ENGINEERING MEASURE Quarterly Report, 29 Feb.–28 May 1965
B. G. Burlingame [1965] 20 p
(Contract DA-36-039-AMC-01475(E))
(QR-8; AD-619770)

The report covers progress made on gold diffusion techniques, partial evaluation of the three-terminal device under simulated operating conditions, and process changes introduced to increase device reliability. Author (TAB)

N66-12549# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR MEASURING THE DURATION OF PULSE FRONTS IN TIME INTERVALS
M. M. N. Vidershayn 13 Aug. 1965 6 p Transl. into ENGLISH from Soviet patent no. 166757 (Appl. no. 853979/26-9, 24 Aug. 1963) 2 p
(FTD-TT-65-641/1+2+4; AD-620821)

Object of the Invention: A device for measuring the duration of fronts and intervals of time which contains a converter of the measurable interval into a pulse, the length of which is equal to the measurable interval, a pulse expander, a counter of the number of pulses developed by a standard generator during the time of the action of the pulse obtained on the output of the pulse expander which has the distinguishing feature that for the purpose of improving the precision of the measurement of short, for example, nanosecond intervals of time, as a pulse expander there is used a semiconductor triode with a circuit transformer feedback into which there is connected a collector-emitter transition (shunt) of a semiconductor triode, and the source of the pulses converted as to length is joined through a semiconductor diode with the base of an auxiliary triode. Author (TAB)

N66-12556# Bureau of Reclamation, Denver, Colo. Electric Power Branch.
REACTOR SWITCHING TESTS OF A VACUUM CIRCUIT BREAKER—FARGO SUBSTATION, MISSOURI RIVER BASIN PROJECT, NOVEMBER 6, 1964
G. W. Cleaveland and C. U. T. Starkenberg 2 Aug. 1965 21 p refs
(EP-10; AD-620956)

A 13.8-kv vacuum-type circuit breaker at Fargo Substation performed well on reactor switching tests, usually clearing at the first current zero after contact part (for the first contact to clear). Average arcing time for the 3 phases was 0.35 cycles. This new-type breaker shows no tendency to restriking but a slight tendency to current chopping with breaker operating at 84% of continuous current rating. Moderate overvoltage transients were recorded during closing operations. The tests demonstrate a very regular pattern of clearing by the 3 interrupters during point-on-cycle switching. This breaker can be expected to provide reasonably maintenance-free reactor switching service and reasonable life within its range of applicability. Since it has low interrupting capabilities (12,000 amp, symmetrical) its use would be limited normally to locations with fault currents at or below this amount. At stations with higher interrupting current capabilities, the advantages of a vacuum breaker can be used for reactor switching service if it is applied between the reactor and the reactor neutral or by protecting the circuit with fuses of adequate interrupting capabilities. Since these tests do not provide information on interrupter life or frequency of contact adjustment, the breaker should be left in service for further study. Author (TAB)

N66-12589# Weston Instruments, Inc., Newark, N. J.
A POROUS SUBSTRATE RESISTOR AIMED AT MINIATURIZATION OF METAL-FILM RESISTORS Interim Development Report, 1 Jun.–31 Aug. 1965
T. Matley and P. M. Gross [1965] 24 p
(Contract NObsr-87542)
(IDR-12; AD-621762)

A ratio parameter has been defined as the length resistance divided by the width resistance. This parameter clearly provides enough information to evaluate terminals when substrate quality and metallizing are controlled. Additional information regarding terminal quality is provided by the % standard deviation in resistance under similar circumstances. Various types of brazed terminals have been evaluated accordingly. It has been determined that a high quality type of brazed terminal still prevents satisfactory metallization. A terminal which can be supplied after heat treatment must be employed and vacuum metallizing may be required in spite of large lot-to-lot variation in resistance. Author (TAB)

N66-12590# Air Force Systems Command, Wright-Patterson AFB, Ohio.
ELECTRONIC OUTPUT RELAY
N. V. Kulikovski 12 Aug. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 163678 (Appl. no. 828931/2C-24, 4 Apr. 1963) 2 p
(FTD-TT-65-636/1+2+4; AD-620783)

An electronic output relay which contains semi-conductor switches and a bridge circuit on the output is described. Two high-frequency generators with double negative feedback are used to assure stability and two semiconductor triodes (transistors) are used to control the working of these generators. Transistors are also used to control inputs of semiconductor switches connected with the output windings of the generators. TAB

N66-12608# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRONIC COMMUTATOR
V. I. Turchenkov 12 Aug. 1965 7 p Transl. into ENGLISH from Soviet Patent no. 161574 (Appl. No. 779890/26-24 24 May 1962), 2 p
(FTD-TT-65-633/1+2+4; AD-620787)

An alternating current electronic commutator is described. The commutator consists of a binary trigger counter, transformers, and diodes. The commutator is distinguished from the known ones by the fact that for the commutation of alternating current from the trigger in it the input windings of two transformers of the following discharge are connected up to the output winding of the transformer of the preceding discharge through diodes connected into both arms of each of the windings of the transformers of the following discharge. To the winding of the first of the transformers of the following discharge the diodes are connected by their anodes, and to the winding of the second by the cathodes. Author (TAB)

N66-12622# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR MEASURING THE CURRENT GAIN OF TRANSISTORS
V. F. Baumgart, A. O. Grundulis, and A. V. Ivans 29 Jun. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 164036 (Appl. no. 832106/26-9, 20 Apr. 1963) 2 p
(FTD-TT-65-206/1+2+4; AD-620094)

The object of the invention is a device for measuring current gain of transistors (value for the coefficient of amplification in current of semiconductor triodes) connected in

accordance with a system with a grounded emitter which contains a power supply connected up through a resistance to the base and the collector of the transistor being tested and a measurer joined with it of the value for the current of the base with a given value for the collector current. For the purpose of simplifying the automation of the process of measurements as a power supply of the base circuit, there is used a generator of linearly changing voltage, and as a measurer of the current of the base there are connected into the base and collector circuits of the transistor, comparing currents joined with an electronic commutator connected between the output of a frequency-stabilized generator of AC and the input of the counter of the periods of oscillation. Author (TAB)

N66-12703 Joint Publications Research Service, Washington, D. C.
MAGNETIC PULSE GENERATOR WITH A FREQUENCY MULTIPLIER
A. P. Makarov *In its* Izv. VUZov: Instr. Bldg., vol. 8, no. 4, 1965 25 Nov. 1965 p 9–15 refs (See N66-12701 03-14) CFSTI: $5.00

In this article, the features of analyzing the operation of a magnetic pulse generator fed by a frequency multiplier are considered. Relationships are obtained which are necessary for computing its joint operation. Author

N66-12787# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHASE MEASURING DEVICE
V. F. Gorneyev and A. M. Savinov 25 Aug. 1965 7 p Transl. into ENGLISH from Soviet Patent no. 162246 (Appl. no. 830273/26-10, 11 Apr. 1963) 1 p
(FTD-TT-65-480/1+2+4; AD-620786)

A phase measuring device, intended for the determination of magnitude of phase angle between two AC signals, is described. The device consists of two transformers, two triggers and a matching amplifier with rectifying bridge. A polarized relay is used for the purpose of obtaining triangular characteristic of amplifier output current from the angle of phase displacement between signals and to assure change in alternation of pulses at amplifier input. The contacts of the relay are connected into one of the channels of phase measuring block. Author (TAB)

N66-12805# Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., Norwood, Mass.
PRODUCTION ENGINEERING MEASURE FOR THE PRODUCTION OF SILICON MONOXIDE CAPACITORS MICRO-ELEMENT Quarterly Report, Mar. 1–May 31, 1965
J. J. O'Connor 27 Jul. 1965 15 p
(Contract DA-36-039-AMC-01478(E))
(QR-8; AD-619880)

A TAR (Technical Action Request) was written and submitted requesting the deletion of the short-term life test and a change in the Insulation Resistance requirements. Work was done to optimize the fabrication methods used for multilayer capacitors with the aim of lowering the D. F. to the required value. Two thousand-hour life tests were completed on all units and the data is being collected and analyzed. Author

N66-12813# Tung-Sol Electric, Inc., Bloomfield, N. J. Electron Tube Div.
ELECTRON TUBES RADIATION RESISTANT PILOT LINE PRODUCTION Seventh Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
William A. Buchanan 28 Feb. 1965 84 p
(Contract DA-36-039-AMC-01476(E))
(AD-621549)

During this quarter all work required by the contract for delivery of Engineering Samples, items 1-1-1B and 1-1-1C, was completed with the exception of the high temperature (500C) life testing of tube types 6360, 6205, and 5886 in Alumino–Silicate glass. Pulse radiation tests were conducted. The results of this test plus those from the steady state reactor test at Brookhaven are given in Appendix II. Sealing of tube type 6205 using RF or heliarc welding techniques was not successful in improving cathode emission. Although good vacuum tight seals were obtained low emission remains a serious problem. Parts of 6080WB tubes are being fabricated to meet the pre-production quantity and delivery date. The ceramic spacers for tube type 6360 have been received and tubes assembled. High temperature bakeout (650C) on exhaust still affects cathode emission. Modifications to the exhaust equipment, considered at the end of the sixth quarter, were made during December. Author (TAB)

N66-12844# Warnecke Electron Tubes, Inc., Des Plaines, Ill.
RESEARCH AND DEVELOPMENT PROGRAM FOR X-BAND CROSSED-FIELD AMPLIFIER Quarterly Engineering Report, 12 Mar.–12 Jun. 1965
B. Giltner et al [1965] 42 p
(Contract NObsr-89504)
(AD-619577)

The first tubes have been consructed and the first hot RF tests have been performed. Although beam synchronism was achieved at some frequencies, the interaction was weak and the gain was poor. No overall gain was achieved because of the high RF attenuation which resulted as the delay line and RF contacts deteriorated during tube operation. Measures for avoiding this deterioration are being incorporated into succeeding tubes. In addition, improvements in the delay line regularity are being made in order to improve the line to beam coupling, and therefore, the interaction. TAB

N66-12850# Advanced Technology Corp., Timonium, Md.
HIGH POWER FERRITE PHASE SHIFTER Final Technical Report
Frederick L. Wentworth Oct. 1965 85 p refs
(Contract AF 30(602)-3495; ARPA Order 550)
(AD-621872)

Theoretical estimates of phase shifter performance as a function of material parameters are presented by examining the results obtained from the small perturbation model used by Button and Lax and from the fully ferrite loaded, parallel plane waveguide model used by Suhl and Walker. The extension of Suhl's theory on nonlinear effects at high power by Fletcher and Silence is applied to relate the material parameters and operating frequency to the magnetic field required to avoid high power subsidiary resonance effects. Experiments designed to demonstrate the relationship of phase shift and loss characteristics to material parameters and configuration for longitudinally magnetized ferrites in rectangular waveguide are described. Polycrystalline ferrites with both cubic and hexagonal structures are examined. Of the hexagonal materials, both uniaxial and planar types with oriented anisotropy fields are discussed. The experimental work leading to the growth of extremely large single crystals of lithium ferrite and their electrical and magnetic properties are reported. Experiments which reduced the linewidth of lithium ferrite samples by heat treatment and polishing are described. High power

tests to 100 kw peak are reported for waveguide configurations containing (1) single crystal lithium ferrite; (2) polycrystalline cubic structure, nickel ferrite; and (3) polycrystalline hexagonal structure nickel–cobalt 'W' ferrite with its magnetic anisotropy oreinted parallel to the applied magnetic field. These high power tests demonstrate that the nonlinear high power effects can be avoided by operating at magnetic fields above ferrimagnetic resonance as prescribed by Fletcher and Silence. Author (TAB)

N66-12882# System Development Corp., Santa Monica, Calif.
PUSH-PULL AMPLIFIER DESIGN
John Staudhammer 23 Aug. 1965 21 p refs
(SP-2175/000/00; AD-622009)

A method is presented that will allow the determination of various parameters in a push-pull connected circuit. The method allows optimization of circuit performance for required output powers. An illustration is included using a prototype audio output stage. Author (TAB)

N66-12884# Naval Research Lab., Washington, D. C.
EXPERIMENTS TO DETERMINE THE EFFECTIVENESS OF ANTENNA GROUND PLANES
F. E. Boyd and W. E. Gustafson (Navy Electron. Lab.) Sep. 1965 16 p refs
(NRL-1646; AD-622226)

Experiments to determine the effectiveness of practical antenna ground planes show that a mesh with 0.05 wavelength spacing is a good compromise between cost and effectiveness under average conditions. This figure could be radically modified should special requirements prevail or different ground conditions exist. Variation of antenna pattern due to ground moisture content is measurable, amounting to as much as several decibels. Burial of ground plane wires is not recommended since it reduces the effectiveness when used in the H.F. of higher bands. Author (TAB)

N66-12948# Maryland Univ., College Park. Dept. of Physics and Astronomy.
PULSE SHAPE DISCRIMINATION
M. L. Roush, M. A. Wilson, and W. F. Hornyak Mar. 1964 47 p refs Sponsored by AEC
(TR-367)

The development of a scintillation counter circuit which would leave the photomultiplier anode signals undistorted for proper use with existing time-of-flight equipment is described. It was desirable to develop a system capable of operating at high count rates and functioning properly over a wide range of pulse amplitudes, with the ability to successfully accept small pulses, thus allowing high neutron acceptance efficiencies. The masking presence of noise pulses generated at the photocathode and early dynodes can present considerable difficulty in certain experimental situations. For example, when geometrical circumstances entail poor optical coupling between scintillator and photomultiplier or when the number of photons generated in the scintillator per event is small, the desired signals may have an amplitude comparable to noise pulses. Consideration is given to discrimination against noise pulses, based on their pulse shape when the desired events involve at least several photoelectrons. R.N.A.

N66-13028# Boeing Co., Seattle, Wash.
DESIGN OF A MONOLITHIC INTEGRATED LINEAR AMPLIFIER
H. M. Austefjord [1964] 93 p refs
(D2-90192-11; AD-468504)

It is the scope of this program to design a general purpose monolithic integrated linear amplifier having a high input impedance and a constant voltage gain over a wide frequency band. These characteristics may be achieved by the use of a combination of two field-effect transistors and a bipolar transistor in the same monolithic block where the field-effect transistors are used to obtain the high input impedance and the bipolar transistor secures a high open loop gain. A constant voltage gain is obtained by resistive negative feedback.
Author (TAB)

N66-13115# Sandia Corp., Albuquerque, N. Mex.
METHODS FOR MEASURING AND CHARACTERIZING TRANSISTOR AND DIODE LARGE SIGNAL PARAMETERS FOR USE IN AUTOMATIC CIRCUIT ANALYSIS PROGRAMS
W. H. Sullivan and J. L. Wirth Jul. 1965 17 p refs
(Contract AT(29-1)-789)
(SC-R-65-941; CONF-650707-3)

The mathematical bases of the Ebers–Moll, Charge-Control and Linvill models are discussed in order to establish the parameter requirements and the accuracy of these models. A recovery technique for measuring those parameters associated with minority carrier storage in devices is described and typical values are given for several high frequency devices. Other parameters, such as current gain and junction depletion capacitance, do not require special measurement procedures and in these cases the characterization of the bias dependence of the parameter is given primary emphasis. The use of the recovery technique in characterizing permanent radiation (neutron) damage and in studying damage mechanisms in transistors is also discussed.
Author (NSA)

N66-13159*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RELIABLE TIME MULTIPLEXING BY REPLACEMENT
John R. Kinkel 15 Nov. 1965 27 p refs
(Contract NAS7-100)
(NASA-CR-68535; JPL-TR-32-828) CFSTI: HC $2.00/MF $0.50 CSCL 09F

This report describes a switching array for time multiplexing using active redundancy at the function level and passive redundancy at the component level to increase reliability. It has been divided into two parts: a description of the multiplexer, and a computer verification of its behavior. Analysis of the multiplexer is based on failure modes instead of failure probabilities. The computer simulation verifies that failure localization occurs, and that it extends the useful life of the multiplexer. Author

N66-13215# Tung-Sol Electric, Inc., Livingston, N. J. Chatham Electronics Div.
HIGH SPEED POWER AMPLIFIER USING AN ELECTRON SWITCHED P-N JUNCTION Interim Development Report, 27 May–27 Aug. 1965
Nelson E. Ake [1965] 22 p
(Contract NObsr-93306)
(QR-1; AD-620920)

A paint on' run was made and diodes were etched from this material for evaluation. The starting material was 'N' and the boron penetration was measured using the 'angle lap stain' technique. The penetration was 1.8 mils. The breakdown voltage measures approximately 800 V and the leakage, (1 sub r), is in the order of 10 microamp at 600 V. A vacuum system has

been modified to include jigging for electrical connection to wafers under vacuum. A heatable platform with a thermometer and variable power supply is also included so that a diode or wafer can be monitored using a curve tracer under controllable conditions of pressures and temperature. Some bare junction diodes have been monitored under various temperatures and pressures (in the order of .01 micron) using this equipment. Diffusion furnaces and the necessary accessories have been readied for: (1) Simultaneous P and N 'paint on', (2) boron pre-diffusion using BBr_3, (3) boron drive and simultaneous oxide growth, and (4) initial oxide growth in steam.

Author (TAB)

N66-13217# Naval Research Lab., Washington, D. C.
LOAD-CARRYING TERMINALS FOR ARMORED ELECTRIC CABLES
E. C. Czul and J. J. Gennari 31 Aug. 1965 22 p refs (NRL-6261; AD-621564) CFSTI: $1.00

Four load-carrying terminals, or sockets, for use with armored electric tow cables, have been designed, developed, and tested at NRL. Two of these designs are mechanically assembled, and two are potted, or cast. In the mechanically assembled design, the attachment of the socket to the load-carrying wires is achieved by mechanically gripping the armor wires between force-fitted friction surfaces. The potted designs use a low-melt-temperature alloy or an epoxy compound which intimately flow about the armor wires. After hardening, the socket is ready for use. The mechanically assembled socket can develop more than 95 percent of the full cable strength before failing; it has been field tested satisfactorily. However, of all the NRL socket types discussed, the authors' preference is for the low-melt-alloy potted type. This type socket has been used at sea for more than a year with good results. The major advantage of this type socket is the ease and speed with which it can be replaced by field workers. Author (TAB)

N66-13251*# National Aeronautics and Space Administration, Washington, D. C.
ELECTRIC CONTACTS [ELEKTRICHESKIYE KONTAKTY]
B. S. Sotskov, I. Ye. Dekabaun, B. N. Zolotykh, R. S. Kuznetsov, and Z. S. Kirillova Dec. 1965 445 p refs Transl. into ENGLISH of the book "Elektricheskiye Kontakty" Moscow, Izd. Energiya, 1964 Proc. of 3d All-Union Conf. on Elec. Contacts and Contact Mater., Moscow, 11–14 Dec. 1962 (NASA-TT-F-339) CFSTI: HC $7.45/MF $2.25 CSCL 09A

Conference articles on electric contacts dealing with the physics of the processes, construction and application, and contact materials are presented. For individual titles see N66-13252–N66-13290.

N66-13260* National Aeronautics and Space Administration, Washington, D. C.
ENERGY LOSSES IN CLOSING CONTACTS MEASURED BY MEANS OF AN OSCILLOGRAPH
V. S. Pellinets *In its* Elec. Contacts Dec. 1965 p 92–98 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

When a RC circuit is closed part of the energy is liberated at the contacts. This energy loss in the contacts lowers the efficiency of the circuit, limits the rate of energy introduction to the load, and destroys the contacts. Oscillographic measurements were made to evaluate these losses and to find a method for decreasing this loss. Results of the experiments were used to derive equations for the calculation and assist in the evaluation of the energy characteristics of specific circuits for a specified range of parameters and states. The discrepancy in the values of the energy computed by means of these equations and the experimental results in the range 25 to 1000 V was not greater than 35% which is considered the characteristic error of the data presented. E.E.B.

N66-13261* National Aeronautics and Space Administration, Washington, D. C.
TRANSIENT CURRENTS AND VOLTAGES WHICH OCCUR IN BREAKING CONTACTS IN A LOW VOLTAGE dc INDUCTIVE CIRCUIT
V. Ye. Kravchuk *In its* Elec. Contacts Dec. 1965 p 99–112 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The transient process which occurs in a switching circuit and at the contacts is characterized by transient current and transient voltage. The transient current and voltage at the contacts determine the nature of contact erosion. The effect of several factors on transient currents and voltages was investigated with simple series dc-inductive circuits with 28 and 120 V using standard switches. Two-beam oscilloscopes were used to record current and voltage. The special features of transient processes are discussed and analytical expressions and coefficients are presented for the calculation and investigation of switching equipment. E.E.B.

N66-13262* National Aeronautics and Space Administration, Washington, D. C.
WELDING OF ELECTRIC CONTACTS AT HIGH CURRENTS
O. B. Bron and N. G. Myasnikova *In its* Elec. Contacts Dec. 1965 p 113–125 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The maximum switching capacity of many devices is limited by the welding of contacts at high currents. This welding can be minimized by prevention of excessively large liberation of heat at the contacts and by the selection of materials. Various contact materials were investigated and their properties determined. It was determined that during the testing of contact materials for resistance to this welding water cooling should be used for all current-carrying elements (contacts, contact holders, and contact bridges). Under such conditions testing may be carried out with prolonged current flow through the contacts without the danger of melting or over heating. Also, water cooling has practically no effect on the temperature of the contact area or the minimum welding current. The criteria for determining the capacity of contact materials to resist welding are minimum current and force necessary to separate the welded contacts. Comparative characteristics of contact materials are tabulated. E.E.B.

N66-13263* National Aeronautics and Space Administration, Washington, D. C.
APPLICATION OF THE ADDITIVITY PRINCIPLE TO THE EROSION OF ELECTRODES IN PULSE DISCHARGES WITH LOW INTERELECTRODE GAPS
A. I. Kruglov *In its* Elec. Contacts Dec. 1965 p 126–136 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The characteristics of electrode erosion which were determined by single pulse discharges was extended to those processes which occur when a train of pulses are used. Under these conditions the electrode erosion is considered an additive process which is determined by the simple addition of individual erosion processes produced by the individual pulses. Investigations were conducted with pulses with a duration of 10^{-6} to 10^{-5} sec at 100 to 200 V. The electrode gap did not exceed 10^{-2} cm. The medium selected for the experiments was kerosene and water. The variation in the magnitude of

erosion produced by a pair of pulses is shown as a function of the interval between the pulses for two values of pulse energy. The magnitude of erosion produced by the pulses reached a maximum when the pulse separation was less than one. This condition is defined as situation when the pulses overlap so that a single pulse with double energy passes through the spark gap. Oscillograms and data are presented to show the variation in erosion as function of the pulse. E.E.B.

N66-13266* National Aeronautics and Space Administration, Washington, D. C.

QUENCHING OF AN ELECTRIC ARC WHEN SWITCHING OFF CURRENTS OF 5–150 A AT 660 V

V. A. Kleymenov and N. I. Korbal' *In its* Elec. Currents Dec. 1965 p 148–157 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The quenching of an electric arc was investigated during the commutation of circuits operating at a nominal voltage of 660 V when switching off current of 5 to 150A. Results show that the arc burns longer than 0.01 sec when switching circuits with a voltage of 660 V. The maximum duration of the arc takes place when the currents are from 15 to 40 A. In equipment with a single stage breaking per phase, the duration of the arc decreases when the contact opening is increased to 7 mm. An increase in the opening above 7 mm does not shorten the arc's duration. In equipment with a two stage breaking per phase without electromagnetic blowing, a contact opening from 5 to 14 mm has no effect on the duration of the arc. In equipment with a single breaking per phase, with a magnetic field present, the rate of contact separation in the range 0.2 to 1.5 m/sec has almost no effect on the duration of the arc. When the magnetic field is absent, the increase in contact breaking rate lowers the duration of the arc slightly. An increase in magnetic field intensity decreases the arc's duration. R.N.A.

N66-13267* National Aeronautics and Space Administration, Washington. D. C.

SILVER CONTACTS AT ELEVATED TEMPERATURE WITH PROLONGED LOADING

O. B. Bron and M. Ye. Yevseyev *In its* Elec. Contacts Dec. 1965 p 158–168 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Recent investigations have suggested that the temperature of silver contacts may be increased, limited only by the allowable heating of current carrying parts adjoining the contacts. To clarify these claims, experiments were conducted using silver contacts of V type switches with a nominal current of 1000 A containing 4 roller contacts connected in parallel. Results show that the electrical resistance of silver contacts during excessive heating above the temperature allowed by present norms and prolonged operation does not increase, but has a tendency to decrease with contact temperature. This is associated with a slow growth in the residual deformation of the heated contacts. Excess temperatures of silver contacts can be increased and for this reason the temperature values allowed by present norms should be increased. R.N.A.

N66-13268* National Aeronautics and Space Administration, Washington, D. C.

THE DETERIORATION OF CONTACTS DURING THE SWITCHING OF LOW VOLTAGE (UP TO 220 V) dc AND ac CURRENTS

V. T. Nezhdanov and B. A. Vasil'yev *In its* Elec. Contacts Dec. 1965 p 169–177 ref (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Investigations were conducted to determine the variation in the electric wear of contacts as a function of contact material and the value of the magnetic field in the arc quenching zone when dc current is switched off, and also as a function of contact separation speed when ac current is turned off. Results are discussed. R.N.A.

N66-13269* National Aeronautics and Space Administration, Washington, D. C.

RESISTANCE OF CONTACT MATERIALS TO ELECTRIC WEAR

O. F. Gayday *In its* Elec. Contacts Dec. 1965 p 178–184 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Electric contacts of silver, SOM cermet (Ag with 5 to 25% CuO), and SOK15 cermet (Ag with 15% CdO) were evaluated for their resistance to electric wear. The evaluation of the contact materials tested in dc contactors showed that the best contacts were those made of silver and of SOM10 and SOK15 cermets. The least wear by weight was exhibited by silver contacts. The wear by weight of the SOM10 and SOK15 cermet contacts was 1.6 to 1.7 times greater than for silver. A transfer of metal from the anode to the cathode occurred with all the tested contacts. This was most pronounced in silver where the depth of depression on the contact reached 2 mm, but less in SOK15 and even less in SOM10. As a result the SOM10 and SOK15 materials were selected for KM-2000 contactors operating with nominal dc currents up to 300 A. The analysis of contact materials tested in ac contactors shows that the maximum number of operations was sustained by contacts made from cermets SOM15, SOK15, and SOM10. As a result these three cermets were selected for use in KM-2000 contactors operating with ac currents up to 150 A. R.N.A.

N66-13270* National Aeronautics and Space Administration, Washington, D. C.

A PHENOMENON AT THE CONTACTS OF A SEALED RELAY

A. V. Gordon, V. N. Gimmel'brodskiy, and O. N. Mikheyeva *In its* Elec. Contacts Dec. 1965 p 185–192 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

A special version of a TKE type electromagnetic switching relay was set up so that dew precipitation on the busbar of the contacts could be observed through a window. Various materials were used for the contact panel, the coil insulation, and other parts of the relay to observe their effect on humidity prevention. A table is given showing the capacity of individual components of the high temperature relay and a conventional relay to absorb and adsorb water. The investigations indicate that the relay must be vacuum-sealed or ventilated; that the complete elimination of the effect of humidity on the operation of the contact system can be achieved only in a hermetically sealed relay; and that the materials used in relays must have a minimum capacity to absorb and adsorb water. Ventilated designs eliminate the formation of moisture in the relay volume, reduce the danger of current-carrying bridges, and reduce the icing of contacts and the formation of insulating films on these contacts due to the precipitation of volatile substances given off by the components of the relay. L.S.

N66-13271* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF MOISTURE ON THE FORMATION OF CURRENT-CARRYING BRIDGES ACROSS ELECTRIC CONTACTS MADE OF DIFFERENT MATERIALS

G. N. Volosevich *In its* Elec. Contacts Dec. 1965 p 193–204 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The tendency of different contact materials to form current-carrying bridges in the presence of moisture is investigated. A device for studying these formations was constructed, and the necessary conditions simulated by introducing a drop of distilled water into the contact gap and applying the necessary voltage to the contacts. Results show that silver, rhenium, copper, and compositions with a large content of these metals are strongly susceptible to this phenomenon; nickel, gold, palladium, platinum, and their alloys are most resistant. It was also found that the most intense formation of current-carrying bridges takes place with dc current; the time for formation in ac current is very small and, for practical purposes, does not depend on the applied voltage. M.G.J.

N66-13272* National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF CAM CONTRACTS OF PUNCHED CARD MACHINES

V. Dauknis, I. Mayauskas, G. Prantskyavichyus, and V. Ryauka *In its* Elec. Currents Dec. 1965 p 205–211 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

In order to obtain information on the special features associated with operation and useful life, the cam contacts on punched card machines were investigated. A schematic is included to show the cam disk, movable contact, and stationary contact, and details on cam operation are reviewed. The condition of the contacts was checked by (1) periodically measuring the contact resistance with an ammeter and a voltmeter; and (2) determining the instant of time for each contact when it begins to conduct a current which is insufficient for operating the relay. The parameters of the failure control circuit were selected separately for each investigation, with the power circuit characteristics taken into account. Checking of contact failures was carried out every $5 \cdot 10^5$ commutations, with the resistance measured every 10^6 commutations. Test results show that an increase in the contact pressure decreases the period of failure-free operation. It was also established that volumetric wear is directly proportional to the number of revolutions of the cam disk and to the static pressure on the roller. M.G.J.

N66-13273* National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF NEW CONTACT SYSTEMS FOR MINIATURE HIGH-FREQUENCY SWITCHES

I. G. Mordukhovich and N. P. Barshteyn *In its* Elec. Contacts Dec. 1965 p 212–221 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The variation in the transitional resistance of contacts as a function of contact pressure was determined under static conditions. It was observed that the nature of the variation in the contact resistance as the contact pressure is increased does not depend on the contact system design or on the materials. The results of the magnitude and variation in the contact resistance are given as a function of contact design, material, number of commutations, and the value of the commutated current during operation. The lowest variation in the transitional resistance was observed in the case of the contact pair whose leaves were made of brass plated with 10 microns of silver and 1 to 2 microns of rhodium. The insignificant variation in the transitional resistance during operation was due to the low coefficient of friction between these materials. A decrease in the value of the switched current from 300 to 50 mA did not change the qualitative nature of the curves for the transitional resistance. E.E.B.

N66-13274* National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF PLUG-TYPE CONNECTORS OPERATING WITH MICROCURRENTS AT MICROVOLTS

A. I. Fedorov and G. Z. Zakirov *In its* Elec.Contacts Dec. 1965 p 222–233 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Reasons for the disappearance and spontaneous restoration of current in a low power circuit using electric contacts are discussed, and the basic electric characteristics of contact pairs were investigated to clarify this phenomenon. The volt-ampere characteristics of contact pairs were studied to determine the transitional resistance variation as a function of different factors; from this, it was possible to find the limiting voltage at which cylindrical contacts lose their capacity to conduct a current. As a result of the study, the lower limit of dc voltage was established, with the specific values of thermo-emf and the temperature differences between the stems of the plug and the jack considered. The lower limit of ac voltage with a frequency up to 20 kc was also established, by taking into account the optimum signal-to-noise ratio. M.G.J.

N66-13275* National Aeronautics and Space Administration, Washington, D. C.

HEAVY DUTY CERMET SWITCHING CONTACTS

I. P. Melashenko and K. V. Gubar *In its* Elec. Contacts Dec. 1965 p 234–244 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Investigations are discussed in which methods were developed for the industrial production of finely dispersed cermet compositions. Also, switching contacts fabricated from these compositions were investigated. Particles were obtained by a combined precipitation of carbonates from solutions of nitrate salts of silver and cadmium using equal amounts of saturated solutions of sodium bicarbonate. The dimensions of the particles were studied as a function of precipitation reaction time, temperature of the precipitating agent, concentration of initial solutions, and the intensity of their mixing. C.T.C.

N66-13276* National Aeronautics and Space Administration, Washington, D. C.

DEVELOPMENT AND INVESTIGATION OF HEAVY DUTY FINELY DISPERSED CONTACTS

N. N. Smaga, B. A. Yudin, and Ye. V. Markov *In its* Elec. Contacts Dec. 1965 p 245–251 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

A method is presented for preparing a finely dispersed material of silver-copper oxide composition, and contact switches fabricated from this material are evaluated. The contacts were tested for electrical wear and found to handle short circuits up to 40 kiloamperes. The contacts also performed multiple switching of nominal currents of 100 amperes. It is concluded that this method is superior to the technology used in powder metallurgy. C.T.C.

N66-13277* National Aeronatutics and Space Administration, Washington, D. C.

Cu-Co AND Ag-Cd CERMET CONTACTS

A. B. Al'tman and E. S. Bystrova *In its* Elec. Contacts Dec. 1965 p 252–257 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

A brief description is given of a method for preparing Cu-Cd and Ag-Cd cermet alloys without a cadmium loss. The

cermet alloys are prepared by mixing copper powders and metallic cadmium in ratios necessary to obtain a given chemical composition. The mixture of powders is pressed and then fired in an atmosphere of protective gas (argon) at high pressure in a charge consisting of a mixture of high melting metallic oxide powders and cadmium oxide (or metallic cadmium). The magnitude of cadmium loss during the firing of Cu-Cd as a function of charge composition is shown in tabular form. Results of investigating breaking electric contacts and collector plates fabricated from these materials are included.

C.T.C.

N66-13278* National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF ELECTRIC CONTACT EROSION OF TUNGSTEN–RHENIUM ELECTRODES

M. I. Tishkevich *In its* Elec. Contacts Dec. 1965 p 258–260 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

It is reported that electric contact erosion was studied to obtain erosion diagrams for tungsten–rhenium electrodes. Experiments were conducted with a switching frequency of 11 or 12 cps and a contact time of the order of 10^{-2} sec. The potential in the circuit was 12 volts and the average current three amperes. The erosion of eight contacts was determined simultaneously by weighing, and the results are given in tabular form. Among the conclusions are that the erosion of electrodes decreases as the amount of rhenium in the sample increases, and that the cathode has two to four times less resistance to erosion compared with the anode. C.T.C.

N66-13279* National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF BREAKING CONTACTS FOR IGNITION ASSEMBLIES

Z. S. Kirillova and A. G. Morozova *In its* Elec. Contacts Dec. 1965 p 261–269 ref (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

To meet the increasing technical requirements for ignition system breaking contacts, spark formation and arc formation testing were conducted of platinum and iridium alloys; palladium and iridium alloys; various alloys ot palladium with rhenium, tungsten, and silver; silver alloys; and cermet compositions of tungsten and rhenium. Test methods are described, and the results characterizing the erosion stability of these materials are tabulated. The data indicate that the palladium alloys exhibited poor erosion stability, even though the hardness was increased by a factor to 2 to 2.5 after dispersion hardening. The alloy of platinum with 60 percent iridium exhibited erosion stability, total absence of welding, and uniform wear; the alloy of tungsten with 20 percent rhenium also showed high stability to arc and spark erosion, produced no welds during operation, and had uniform wear over the entire contact surface. M.G.J.

N66-13280* National Aeronautics and Space Administration, Washington, D. C.

THE POSSIBILITY OF USING CERMETS TO REPLACE TUNGSTEN

G. A. Bugayev *In its* Elec. Contacts Dec. 1965 p 270–275 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Experiments were conducted to determine the feasibility of replacing tungsten contacts with a composition possessing higher corrosion and wear resistance properties, particularly in tropical climates and in locations with high humidity. Switching capability, resistance to electric wear, and contacting reliability were the main parameters checked; test details and results are given. Data indicate that none of the known compositions containing silver can provide a commutation capability close to that of the tungsten contacts. Therefore, it was concluded, replacement of tungsten with cermets does not appear feasible for vibratory relays with a high operating frequency. M.G.J.

N66-13281 National Aeronautics and Space Administration, Washington, D. C.

SPECIAL FEATURES OF SWITCHING LOW LEVEL CURRENTS AND VOLTAGES BY MEANS OF CONTACTS

T. K. Shtremberg and D. V. Gayevskaya *In its* Elec. Contacts Dec. 1965 p 276–300 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The results of a study on relay contacts used in switching a nonreactive circuit of 5μA and 50 mV at a switching rate of 5 pulses/sec are presented. During the tests, the loss of contacting was recorded by a special device with a counter, making it possible to establish the total number of complete and partial disruptions in contacting. Among the contact materials tested were technically pure platinum and its alloys with rhodium; rhodium and iridium; palladium and its alloys with platinum, rhodium, iridium, osmium, ruthenium, silver, and copper; 999th test silver; and gold and its alloys with platinum, palladium, silver, nickel, and zirconium. Results indicate that technically pure gold is the most suitable material for switching of low level voltages and currents. Under normal climatic conditions silver produces results comparable to gold; however, its performance changes radically in high temperature and humidity. Metals of the platinum group and their alloys were found unsuitable as the organic vapors form powder-like deposits with high electric resistance on contacts made of these materials. M.G.J.

N66-13282* National Aeronautics and Space Administration, Washington, D. C.

CONTACTS OF RELAY-TYPE ELEMENTS AND MICROSWITCHES WHICH COMMUTATE LOW LEVEL SIGNALS

S. F. Solov'yeva, I. I. Sigachev, N. A. Surkova, and Ye. V. Kogteva *In its* Elec. Contacts Dec. 1965 p 301–331 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Various alloys were investigated in an effort to find contact materials suitable for breaking contacts which are not hermetically sealed. Other factors involved reliable current switching in the $1{\cdot}10^{-6}$–0.5 A range, with voltages from 0.5 to 30 V after prolonged storage. Materials selected include silver and alloys of Ag–Pd; gold and alloys of Au–Pd, Au–Ni, and Au–Zr; platinum and alloys of Pt–Ni, Pt–Rh, and Pt–Pd; and palladium and alloys of Pd–Ag. Methods of investigating the electric and physical properties of surface film formation, due to interaction with the atmospheric medium, are described. Results establish that only gold and platinum alloys can be used in contacts which switch low level signals. Studies were also conducted to determine the effect of organic vapors in hermetically sealed designs. The contact materials were used in conjunction with plastics, or insulating materials. The recommendation was made that silver and gold plus 3 percent zirconium, in combination with the insulating materials, be used for switching elements, as the thin films formed have a transitional resistance no greater than a few tenths of an ohm. M.G.J.

N66-13283* National Aeronautics and Space Administration, Washington, D. C.

ELECTROPLATING OF SWITCHING CONTACTS

S. Ya Grilikhes and D. S. Isakova *In its* Elec. Contacts Dec. 1965 p 332–347 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Methods for plating contact elements with precious metals are described, with emphasis placed on the electrolysis conditions affecting the mechanical and electric properties of the deposits. Samples were plated and tested for wear resistance, and the transitional resistance value; plating thickness was usually three microns. Techniques studied included plating with silver and its alloys; gold and its alloys; palladium and its alloys; rhodium plating; and ruthenium plating. Tabular data show the test results on the durability of electrolytic platings under various plating conditions, and on the stability of platings made with different current loads under conditions of erosion wear; figures depict the effect of the surrounding medium on the transitional resistance of the platings. Results indicate that for improved operating characteristics (1) silver platings should be replaced with palladium platings; and (2) as electroplating conditions affect the mechanical and electric properties, palladium plating of contacts should be done in an aminochloride electrolyte for higher wear resistance and smaller transitional resistance. M.G.J.

N66-13286* National Aeronautics and Space Administration, Washington, D. C.

THE RELIABILITY OF THE ELECTRIC CONTACT

B. S. Sotskov and I. Ye. Dekabrun *In its* Elec. Contacts Dec. 1965 p 376–384 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

In discussing switching contacts, the point is made that their reliability depends on the operating conditions of the circuits and on the load parameters, and that reliability can be achieved by proper selection of the operating conditions. Equations are given for determining these conditions for all four stages: open circuit; contact closure; contact release; and when the circuit makes. Figures are included to depict the probability of failures and reliability of relay release when the closed circuit is being opened; failure of contact to close as a function of contract pressure; variation in contact closure reliability as a function of contact pressure; probability of failures and reliability of contact closure; reliability of the circuit breaking; and probability of retaining contact resistance within given limits. M.G.J.

N66-13287* National Aeronautics and Space Administration, Washington, D. C.

THE RELIABILITY OF ELECTROMAGNETIC RELAY CONTACTS ACCORDING TO OPERATIONAL DATA

G. Ya. Rybin *I n its* Elec. Contacts Dec. 1965 p 385–387 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Investigations of relay failures showed that in over 60 percent of the cases failures are caused by relay contacts (the entire contact system), up to 27 percent are due to failures in the windings, and approximately 13 percent are due to defects in the moving system of a relay and to mechanical failure of individual components. Of the total, about 80 percent are of the break type, while 20 percent are of the short circuit type. Up to 90 percent of failures take place during the first 1000 to 1200 hours of operation, due to concealed manufacturing defects and the misalignment of the contact system which is also attributable to these defects. Among the recommendations made for improved reliability are: (1) in switching loads which have a reactive nature, the switched current should be decreased by a factor of not less than 2 to 4 with respect to the nominal value; and (2) in switching small currents and voltages, gold or gold-plated contacts should be used. M.G.J.

N66-13288* National Aeronautics and Space Administration, Washington, D. C.

THE USEFUL LIFE OF PLATINI–IRIDIUM RELAY CONTACTS AS A FUNCTION OF LOAD CURRENT

T. K. Shtremberg and N. A. Belozerova *In its* Elec. Contacts Dec. 1965 p 388–406 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

A schematic diagram of a test setup has been presented for recording failures of contacts incorporating an automatic termination of switching in the event of any failure, and with a device which makes it possible to determine the nature of the failure and to identify it with one of two contact pairs, handled by one recording mechanism. The operation of this test setup to determine the useful life of contacts has made it possible to collect statistical data and to determine the distribution law for the life of contacts. It was shown that the latter satisfies the normal logarithmic law. Norms for the useful life of contacts were established for a series of miniature relays for certain loads. The variation in the limiting useful life of platini–iridium contacts as a function of current in nonreactive loads was established for the range 0.8 – 5 amperes and 30 – 32 volts. Empirical equations were obtained showing the variation in the limiting useful life of platini–iridium contacts as a function of contact current. This made it possible to determine the approximate life of contacts for any contact currents in the range 0.8 – 0.5 amperes based on the testing of contacts at any one of two loads. Author

N66-13289* National Aeronautics and Space Administration, Washington, D. C.

DETERMINING NORMS FROM THE BASIC ELECTRIC PARAMETERS OF CONNECTOR CONTACTS

V. S. Savchenko *In its* Elec. Contacts Dec. 1965 p 407–425 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The thermal states of contact devices are analyzed in order to find their basic electric parameters, and a method of computing them is presented. It was determined that the norms for the transitional resistance value depend on the values of the assigned operating currents and on the excess temperature of the apparent contact surface; the norm for the contact resistance value depends on the assigned values of operating currents and the excess temperature of the contact body. Both norms depend directly on the norm for the instability of the transitional resistance in the static and dynamic state. An equation is written to satisfy the condition for an identical temperature state for various contact diameters. The norm for the contact resistance value is expressed as the average value of the contact resistance taken from three readings; the norm for the contact resistance value is determined for a connector of definite diameter and for a single-contact snap connector. To provide for an identical temperature operating state of the central contact in a multiple-contact snap connector, a load current coefficient was introduced, with its value depending on the diameter of the connector and on the number of contacts. M.G.J.

N66-13290* National Aeronautics and Space Administration, Washington, D. C.

A SYSTEM FOR RECORDING FAILURES

A. Yu. Gorodetskiy *In its* Elec. Currents Dec. 1965 p 426–437 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The circuits described make it possible to record the failure of test contacts to close or to open. The type of failure is determined by the operation of a particular RK relay and by the position of the test relays at the instant of failure. In cases concerned only with failure to close or with failure to open, the circuits may be simplified. The particular system selected for testing relays depends on the specific requirements. If testing is conducted under specific conditions, the circuits with electromagnetic relays, for example, relays of the RPN type may be

used. In this case, because these circuits have a limited sensitivity, it is necessary to evaluate the effect of the test circuit on the test conditions. When testing is carried out over a wide range of loads, it is desirable to use electronic dircuits which are more universal. The lower range of test voltages is determined by the types of electromagnetic relays and by the types of vacuum tubes. With use of the double triodes with a medium emplification factor and with use of the RPN type relay, the electronic circuits may operate with a minimum voltage of 5-10 volts. Author

N66-13292*# General Electric Co., Schenectady, N. Y. Tube Dept.
HIGH-TEMPERATURE, GAS-FILLED, CERAMIC RECTIFIERS, THYRATRONS, AND VOLTAGE-REFERENCE TUBES Quarterly Progress Report No. 3, 15 Jun.–14 Sep. 1965
E. A. Baum [1965] 17 p
(Contract NAS3-6469)
(NASA-CR-54795) CFSTI: HC $1.00/MF $0.50 CSCL 09A

This report is concerned with advancing the high-temperature tube technology and establishing basic design data and concepts for gas tubes operating in high-temperature environments. Basic designs were established for the high-temperature thyratron device and voltage-reference tubes, and data were obtained for tube temperatures up to 750° C. Based on these data, design changes were incorporated. Six tubes were put on test. Of these, two tubes failed within a few hours because of vacuum leaks. One tube a hollow-anode structure, developed a vacuum leak in the grid seal, while another tube developed a crack in the molybdenum anode flange. The remaining four tubes were tested at temperatures up to 760° C and over the frequency range of 60 to 3000 cycles per second. One tube was operated for approximately two hours at 6000 cycles per second at 1700 volts peak inverse voltage. Endurance tests on the voltage-reference tubes have been started. The first tubes were operated for a total of 330 and 354 hours, respectively. Both tubes were operated at 50 milliamperes with a running voltage of 127 volts. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-12201*# National Aeronautics and Space Administration, Washington, D. C.
AUTOMATIC CONTROL AND METHODS OF ELECTRIC MEASUREMENTS. VOLUME II: THEORY OF DATA PROCESSING SYSTEMS. AUTOMATIC CONTROL SYSTEMS. ELECTRONIC MEASUREMENT OF NONELECTRIC QUANTITIES [AVTOMATICHESKIY KONTROL' I METODY ELEKTRICHESKIKH IZMERENIY, TOM II. TEORIYA IZMERITEL'NYKH INFORMATSIONNYKH SISTEM. SISTEMY AVTOMATICHESKOGO KONTROLYA. ELEKTRICHESKIYE IZMERENIYA NEELEKTRICHESKIKH VELICHIN]
K. B. Karandeyev, ed. Dec. 1965 287 p refs Transl. into ENGLISH of the Proc. of the 4th Conf. on Autom. Control and Methods of Elec. Meas. Novosibirsk, Izd.-Vo Sibirskogo Otdel., Akad. Nauk SSSR, 1964
(NASA-TT-F-384) CFSTI: HC $6.00/MF $1.50 CSCL 09C

Conference papers on the theory of data processing systems, automatic control systems, and electric measurement of nonelectric quantities are presented. For individual titles see N66-12202–N66-12241.

N66-12202* National Aeronautics and Space Administration, Washington, D. C.
EXPANDING THE CONCEPTS OF AUTOMATIC CONTROL
F. Ye. Temnikov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 1–3 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Concepts of control, measurements, signaling, and identification are discussed in general terms of automatic control systems. Control is considered as a process of receiving information from a machine or a human operator; and the cycles of information processing are illustrated for an automatic system. It is pointed out that operational characteristics, such as simplicity, adaptivity, self-learning, self-control, self-protection, and self-recovery, are determined by the level of development of the devices. M.W.R.

N66-12203* National Aeronautics and Space Administration, Washington, D. C.
CLASSIFICATION OF STATISTICAL MEASUREMENT INFORMATION SYSTEMS
B. S. Sinitsyn *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 4–13 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Characteristics of many statistical measurement information systems (SMIS) are explained and their use in determining variable physical quantities is considered. When systems are used for the statistical processing of results, then only static properties need be considered. It is necessary to analyze the dynamic properties of the SMIS in cases where measurements are made of rather slowly varying quantities, which at any instant of time are considered to be constant. Devices which have a compensating correlator are, therefore, considered as are bridge systems in which a correlator is used to establish the degree of system unbalance or to compare several parameters in a circuit. Correlation systems for random search are also discussed. While self-adjustment is achieved in most adaptive SMISs by varying certain internal parameters of the system, it is possible to design systems designated as self-arranging. A statistical approach permits the development of measurement techniques which can be extended to the area of random processes and fields of existing methods as well as to the construction of a series of new measurement systems. M.W.R.

N66-12206* National Aeronautics and Space Administration, Washington, D. C.
STATISTICAL REGISTRATION OF A LARGE NUMBER OF QUANTITIES DURING THE AUTOMATIC CENTRALIZED CONTROL OF INDUSTRIAL AND TEST PROCESSES
F. Ye. Temnikov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 30–33 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Four statistical single unit recorder–indicators are proposed to represent a large number of quantities obtained during the automatic centralized control of industrial and test processes. This permits an overall evaluation of all the parameters without establishing the location of individual breakdowns. The components are identified from information stored in memory devices or on punched tape. These four units are described as: (1) a graduated device with a row of lamps or electroluminescent units whose brightness is a function of the

distribution density of deviations; (2) a horizontal device with a discrete mechanical indicating elements which are displaced by the action of step micrometers; (3) a device using balls which has a series of electromagnetic traps corresponding to the number of discrete steps in the two-sided deviation scale; and (4) a point recording device which is a scanner. M.W.R.

N66-12208* National Aeronautics and Space Administration, Washington, D. C.
TWO FORMS OF THE EXPRESSION FOR DISTRIBUTIONS
M. L. Platonov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 38–48 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

It is assumed that the numeric values for a random quantity occur because of the action of certain operators, and two finite discrete distribution expressions (A and B) are given which may be simulated by schemes whose prototype is the Galton board. A model of the B-distribution is easily obtained by use of real and transformed base elements. While the A-distributor has the same form, the distribution ratios in each unit are computed in a more complex manner. By use of such distributors it is possible to simulate results which are obtained when various operators are applied to functions. Other equations can be simulated by assigning different values to the transformation operator. While the base elements may be regarded as functions of time, other arguments may be used in a simulation of this kind. Introduction of variable elements extends such simulation possibilities and makes it possible to consider distributions for both random quantities and random processes. Solutions are diagrammed for the Riccati equation and for ordinary linear and differential equations. M.W.R.

N66-12209* National Aeronautics and Space Administration, Washington, D. C.
THE GENERATION OF PARAMETERS FOR THE FUNCTIONAL RELATIONSHIP $y=\sum_{j=0}^{n} a_j x^j$ IN MEASUREMENT DEVICES
P. Ye. Tverdokhleb *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 49–58 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Numerical values are obtained of the parameters for the functional relationship of two physical quantities of the form

$$y=\sum_{j=0}^{n} a_j x^j$$

in measurement devices. Obtaining parameters a_j is reduced to sequential accumulation of the results of direct measurements with positive and negative whole number coefficients. The expressions for computing a_j are realized with relative ease if the a multiple addition operation replaces the operation of multiplying the results of y_i by a whole number coefficient. The number of addition operations are given, as are the number of addition operations necessary when $n = 5$ for both a_0 and a_1. Expressions for computing the parameters are evolved. M.W.R.

N66-12211* National Aeronautics and Space Administration, Washington, D. C.
APPLICATION OF THE THEORY OF FLOW GRAPHS TO THE ANALYSIS OF ELECTRONIC CIRCUITS
D. N. Bolotin *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 67–74 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Concepts of the theory of flow graphs are presented in the form of an empty set X consisting of subsets V and I, with transformations of set X in X. In an analysis of electronic circuits, an amplifier stage is designed by this method; and an expression is obtained which associates the amplification factor with the parameters of the amplifier stage provided with negative current feedback. Matrix and oriented-graph methods of designing electric circuits are compared, and the necessary steps for each are given. It is noted that the matrix method is more convenient when a computer is used for making the calculations. Oriented normalized graphs can be used when a computer is unavailable and in systems whose graphs coincide with their block diagrams. M.W.R.

N66-12212* National Aeronautics and Space Administration, Washington, D. C.
STATIC ACCURACY OF MULTI-LOOP MEASUREMENT SYSTEMS AND AUTOMATIC SYSTEMS
P. I. Dekhtyarenko *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 75–84 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

An analysis is made of the static accuracy of multiloop measurement systems, and their stability is evaluated under varying parameters. To make the output quantity independent of the various perturbations, an auxiliary internal positive feedback loop is proposed for a system which operates on the principle of deviation. It is shown that when the tuning is precise the condition invariance is satisfied when the amplification factor is equal to infinity; therefore, it is not rational to use the concept of deviation under these conditions. Rather, the amplification factor should be determined as a function of precision with which the condition of invariance is carried out. A system which is open with respect to perturbation is also considered. Relative deviation is determined for both systems when the conditions for invariance are not exactly satisfied. M.W.R.

N66-12217* National Aeronautics and Space Administration, Washington, D. C.
POLAR CORRELATORS AND THEIR APPLICATION
A. N. Domaratskiy and B. S. Sinitsyn *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 105–109 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

The reading and processing of data can be greatly simplified by use of the principles of polar correlation. The resultant correlators are multichannel devices with considerable speed. The initial expression associates polar correlation with the distribution law; the actual determination of the probabilities, assuming the ergodic nature of the investigated processes, is transformed to a time-averaging procedure. Final values of the normalized correlation function are determined from the probability of the coincidence or noncoincidence of the signs associated with the investigated processes. At the expense of some information loss in determination values of the normalized correlation function, it is possible to design simple, high speed correlators; and two variations in design are proposed. M.W.R.

N66-12255*# General Electric Co., Daytona Beach, Fla.
SINGLE PARAMETER TESTING APPLICATION
E. L. Berger and J. C. Jackson Washington, NASA, Dec. 1965 30 p refs
(Contract NAS8-11715)
(NASA-CR-339) CFSTI: HC $2.00/MF $0.50 CSCL 09E

Single parameter testing with growing exponential signals was applied to a servo-loop controlling arm position on an X-Y plotter, for the purpose of establishing the test procedure for a physical system and to gain insight into practical limitations. A block diagram of a basic servo loop consisting of an input attenuator, a chopper network, a servo amplifier, a two-phase a-c motor, and a compensation network that feeds back voltage proportional to position; and a block diagram of an arm position control loop model used are depicted. In general the results of the tests on the X-Y plotter are weaker than initially expected since no specific quantitative results can be stated; but qualitative results and observations made during the tests showed an improved testing procedure for more complex systems. It was shown that the practical sensitivity of the growing exponential technique to variations in parameter values depends strongly on how close the input probing signal is matched to the partial derivative of the system function. Other observations are also given. L.S.

N66-12438# Mound Lab., Miamisburg, Ohio.
A GENERAL METHOD OF DETERMINING THE TOTAL TIME INTEGRAL OF TRANSIENTS IN LINEAR SYSTEMS
K.C. Jordan 1 Feb. 1965 18 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1288) CFSTI: $1.00

A general method is derived whereby the total time integral of the current through any branch or the voltage between any two modes of an electrical circuit, which has been subjected to a driving force of finite duration or to a unit-step driving force, may be calculated by analyses involving only steady-state direct-current circuit theories. In cases where the equation of the transient is known, the exactness of the equation may be checked by taking the total time integral of the transient terms and comparing with the exact integral obtained by the method presented. In an example, a relationship of parameters is derived which will result in zero deflection of a ballistic galvanometer in a circuit used to measure mutual inductances. Another example demonstrates the application of this method to transient heat-flow problems with distributed parameters. The exact equation is presented and checked by the total time integral, which is then used to fabricate an approximate solution that is in good agreement with the exact solution. The application of the method to heat capacity measurement is described. Author

N66-12501*# Georgia Inst. of Tech., Atlanta.
THIN-FILM RC LINES WITH RESEMBLING OPEN-CIRCUIT CHARACTERISTICS
Kendall L. Su [1965] 8 p ref
(Grant NGR-11-002-020)
(NASA-CR-68290) CFSTI: HC $1.00/MF $0.50 CSCL 09C

A quantity is defined for comparing the low-pass voltage-transfer characteristics of non-uniform RC lines. This quantity is the frequency ratio of the 30-db and the 3-db points on the characteristic. Lines with the same frequency ratio are said to resemble one another. Author

N66-12638# Naval Ordnance Test Station, China Lake, Calif.
DESIGN DATA FOR STRIP TRANSMISSION LINE, TANDEM QUARTER-WAVELENGTH DIRECTIONAL COUPLERS
Charles B. May Sep. 1965 15 p refs
(NAVWEPS-8766; NOTS-TP-3848; AD-620928)

Design equations are given for strip-line, tandem couplers and graphical data are developed to enable the designer to select physical coupler dimensions for specific applications. Author (TAB)

N66-12704 Joint Publications Research Service, Washington, D. C.
SIMPLIFICATION OF MATHEMATICAL TRANSFORMATIONS FOR DETERMINING TRANSIENT PROCESSES AT THE OUTPUT OF A LINEAR SYSTEM
I. D. Zolotarev *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 16–21 refs (See N66-12701 03-14) CFSTI: $5.00

In this article, the feasibility of simplifying mathematical operations is justified for carrying out the inverse Laplace transform for the case of representative functions with simple pairs of conjugate poles to which the analysis of the passage of pulsed radiosignals through resonant device systems lends itself. Author

N66-12705 Joint Publications Research Service, Washington, D. C.
DESIGNING INPUT FILTERS FOR AUTOMATIC POTENTIOMETERS
F. F. Kotchenko and V. S. Frezinskiy *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 22–26 refs (See N66-12701 03-14) CFSTI: $5.00

One method for stabilizing automatic potentiometer servomechanisms is considered for which an input filter is used as the correcting circuit. To choose parameters for the correcting circuit, a method is proposed based on the application of the Vyshnegradskiy pattern. Author

N66-12706 Joint Publications Research Service, Washington, D. C.
BASIC PRINCIPLES FOR CONSTRUCTING DIGITAL SCANNING CONVERSION DEVICES FOR MEASURING ALTERNATING VOLTAGE VECTORS
T. M. Aliyev *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 27–33 (See N66-12701 03-14) CFSTI: $5.00

In this article basic principles are considered for constructing alternating voltage compensators for scanning conversion. The principal electrical circuits of rectangular coordinate compensators are given and basic relationships characterizing their operation such as error and speed of response are determined. Author

N66-12707 Joint Publications Research Service, Washington, D. C.
VOLTAGE AND CURRENT STABILIZERS WITH A WEIGHT REFERENCE ELEMENT
L. F. Kulikovskiy and O. G. Korganova *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 34–38 refs (See N66-12701 03-14) CFSTI: $5.00

In this article, a brief description is given of the operation of a current and voltage stabilizer whose standard cell is the weight; the limits of stabilization with respect to the voltage and resistance of the load and the stabilization operation precision are considered. Author

N66-12708 Joint Publications Research Service, Washington, D. C.
SCREEN METHOD FOR MONITORING METALLIC TAPES
V. F. Avduyevskiy *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 39–45 refs (See N66-12701 03-14) CFSTI: $5.00

In this article, the electromagnetic processes taking place in a metallic nonmagnetic tape upon measuring its thickness by the screen method are analyzed. Formulas are given for calculating the emf of the secondary coil of the screen detector. Author

N66-12709 Joint Publications Research Service, Washington, D. C.
AN EQUATION FOR THE DETERMINATION OF CHARACTERISTICS OF NONLINEAR SYSTEMS
B. A. Aref'yev *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 46–49 refs (See N66-12701 03-14) CFSTI: $5.00

The article shows how, based on a priori data on the structure of the simulation model of a nonlinear system, it is possible to obtain an equation for the determination of its static and dynamic characteristics, including the instantaneous functions of various types of random input and output signals. The solutions are based on the requirement of the proximity of the probability functions obtained from experimental and calculated data. Author

N66-12710 Joint Publications Research Service, Washington, D. C.
EXTREMAL REGULATOR BASED ON ARRANGEMENT OF LEVEL QUANTIZATION
G. V. Vakhlakov *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 50–55 (See N66-12701 03-14) CFSTI: $5.00

The article considers a new type of an extremal regulator designed on the basis of the development of a level quantization arrangement, differing from previously known ones by the absence of hunting variations at a stationary extremal characteristic. The block diagram of the regulator is described in detail. Author

N66-12711 Joint Publications Research Service, Washington, D. C.
CALCULATION OF TRANSFER PROCESSES IN PULSE SYSTEMS
V. V. Yakovlev *In its* Izv. VUZov: Instr. Bldg., vol. 8, no. 4, 1965 25 Nov. 1965 p 56–59 refs (See N66-12701 03-14) CFSTI: $5.00

An approximate method for designing transfer processes in closed pulse control systems according to a real frequency characteristic is discussed. Author

N66-12721 Joint Publications Research Service, Washington, D. C.
APPLICATION OF THE METHOD OF ELECTROTHERMAL ANALOGIES TO THE ANALYSIS OF THERMAL REGIMES OF RADIOELECTRONIC APPARATUSES
A. I. Kaydanov *In its* Izv. VUZov: Instr. Bldg., vol. 8, no. 4, 1965 24 Nov. 1965 p 130–135 refs (See N66-12701 03-14) CFSTI: $5.00

In this article the principles which are the basis of the method of calculating the thermal regimes of radioelectronic apparatuses of complex design are considered in detail. Special attention is devoted to the method of electrothermal analogies. Author

N66-12791# Illinois Univ., Urbana. Coordinated Science Lab.
A TOPOLOGICAL TECHNIQUE FOR ANALYSIS OF ACTIVE NETWORKS
John T. Barrows, Jr. Aug. 1965 40 p refs
(Contract DA-28-043-AMC-00073(E))
(R-266; AD-621925)

This paper presents a generalization of Fuessner's method for the analysis of active networks. This method makes it possible to determine system functions of any network in a simple and straightforward manner. In the usual topological analysis of networks it is necessary to list all possible trees or co-trees and the signs of their tree admittance products as well as determining the set of 2-tree products and their signs for the network function in question. Usuaully two graphs, a current and a voltage graph, are used to implement this process when dependent sources are present in the network. The method presented here utilizes solely the original topology and the assigned branch current directions to determine these terms and their sign. Justification of the technique is given for the cases of one and two dependent sources present in a network with the summary of the method for each case. The analysis of a network with an arbitrary number of dependent sources is seen to follow directly. Finally an example of a network with two dependent sources is given which illustrates the method. Author (TAB)

N66-12801# California Univ., Berkeley. Electronics Research Lab.
STUDY OF CROSSED-FIELD AMPLIFIERS Quarterly Progress Report, 15 Jan.–14 Apr. 1965
T. Van Duzer and R. A. Rao 15 Apr. 1965 19 p refs
(Contract DA-36-039-AMC-02164(E))
(QPR-7 AD-622089)

A matrix inversion method was used to calculate cathode noise quantities for several types of crossed-field guns. Restrictive assumptions under which a noise-figure expression had been previously derived were removed and a more generally applicable expression was derived. Noise-figure expressions are being used to study velocity jumps as noise reducing transducers. Optimum operating conditions for minimum noise are also being investigated. The first phase of study on crossed-field potential minimum was completed. The assumptions and the space-charge model on which this initial phase was based did not lead to any instability in the crossed-field beam. A more realistic physical model will be assumed and is expected to lead to more useful information on noise phenomena. A new diffusion theory of electron motion in crossed fields was completed. Expressions for the static characteristics of the magnetron were derived and compared with experimental results. Author

N66-12916# General Electric Co., Schenectady, N. Y. Schenectady Tube Operation.
CHARACTERIZING DISPENSER CATHODE SYSTEMS
J. H. Affleck and W. T. Boyd Oct. 1964 20 p refs Presented at the 7th Natl. Conf. on Tube Tech., New York
(Contract AF 30(602)-3395)
(R64ETI-21)

Dispenser cathode systems are frequently characterized by their work function, evaporation rate and sensitivity to environmental effects. The characteristics of several barium dispenser cathodes have been reported. This data and that of previous work indicates its dependence upon the multiple rate processes in these complex systems, the operating environment, and measurement techniques. Although the emission mechanism in barium dispenser systems is frequently described as resulting from a monolayer of barium and/or barium oxide on a refractory surface, it is more apt to depend upon barium oxide in the pores of the matrix or in patches on the surface. Systems that exhibit emission characteristics similar to oxide coated cathodes also have evaporation rates similar to that of barium oxide. The effects of low mass gases on the dispenser system is similar to the results reported for the oxide cathode. Author

N66-12952# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
COMPUTATIONAL TECHNIQUES FOR THE SYNTHESIS OF OPTIMUM NONUNIFORM TRANSMISSION LINES BASED ON VARIATIONAL PRINCIPLES

M. R. Wohlers, R. E. Kopp, and H. G. Moyer Oct. 1965 11 p refs Presented at 21st Ann. Natl. Electron. Conf., Chicago, 25–27 Oct. 1965
(RM-298J)

The application of variational techniques to the design of nonuniform distributed transmission lines is discussed. Three general types of problems are formulated so that they can be solved by these techniques. The first considers the coupling of a specific passive load to a source with a prescribed output impedance in such a way that the power transferred to the load is maximized over some band of frequencies. The radar cross section reduction problem concerns the matching of a given source to a short circuit load by using a lossy two-port network, so that minimum energy is reflected from the network over a prescribed band of frequencies. In the problem dealing with broadband transmission line amplifiers, the nonuniform line is realizable because the parameters of the matching networks are positive; however, the stability of the overall systems must be verified separately. The Pontryagin maximum principle is used as the basis for various computational algorithms, and numerical methods for solutions are discussed. A solution to a specific problem is also included. M.G.J.

N66-13048*# Westinghouse Electric Corp., Baltimore, Md.
RESEARCH ON FAILURE FREE SYSTEMS, PHASE II Final Report
Washington, NASA, Dec. 1965 168 p refs
(Contract NASw-572)
(NASA-CR-343) CFSTI: HC $5.00/MF $1.00 CSCL 09C

A new technique for more effectively employing redundant equipment to increase the useful life of electronic digital systems was developed. The technique was devised for a class of digital systems having a high degree of homogeneity among the subsystems within each system. Work in developing this technique and in evaluating its effect on the reliability of this class of digital systems is described in three sections. The first section indicates the need for highly reliable systems and describes techniques which were developed for achieving high reliability. Included is a description of the failure response systems of primary interest. The second section describes techniques which were considered in attempts to develop mathematical expressions for the reliability of failure responsive systems. The failure of the techniques to adequately describe these systems resulted in the formation of a computer simulation program. The final section describes the measure of effectiveness which was established as a means for comparing the different organizational strategies. Also included are the results obtained from the simulation program, curves representing the combined results of thousands of simulated system failures, and conclusions which can be reached from observing the curves. R.N.A.

N66-13168*# Pennsylvania State Univ., University Park.
A GENERAL STABILITY CRITERION FOR FEEDBACK SYSTEMS
Allan M. Krall [1964] 10 p refs
(Grant NGR-39-009-041)
(NASA-CR-68544) CFSTI: HC $1.00/MF $0.50 CSCL 09C

If a feedback system is described by a system of linear differential equations with constant coefficients, there are many techniques for determining whether or not the system is stable. If the coefficients are dependent on time, then stability can be determined by comparing the system to one with constant coefficients. If the system can only be described by nonlinear equations, stability can be determined by various approximations. Two general stability theorems, which cover a great many situations and which, even in the linear case with constant coefficients, give usable results are presented together with proofs. Further, the theorems considered can be generalized to multiloop systems. E.E.B.

N66-13179# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
PECULIARITIES OF BEHAVIOR OF HYBRIDE WAVES IN A CIRCULAR WAVEGUIDE PARTIALLY FILLED WITH AN ANISOTROPIC DIELECTRIC
V. A. Vagin, V. I. Kotov, and M. M. Ofitserov 1965 11 p refs In RUSSIAN
(JINR-P-2274) CFSTI: HC $1.00/MF $0.50

The behavior of hybrid waves in a circular waveguide partially filled with anisotropic dielectric medium which is characterized by a diagonal singly degenerate tensor is treated. A dispersion relation was obtained and its analysis is given. The existence of two classes of hybrid waves is shown and their properties are investigated when the tensor components are changed. One of the cases was considered when the cutoff frequencies of two hybrid modes coincide. The existence of inverse waves was proven. The results of the calculation are illustrated by the graphs. Author (NSA)

N66-13201# Illinois Univ., Urbana. Coordinated Science Lab.
A CLASS OF FLAT DELAY FILTER NETWORKS AND THEIR TRANSIENT RESPONSES
G. Kishi Aug. 1965 42 p refs
(Contract DA-28-043-AMC-00073(E))
(R-256; AD-619727)

The transfer functions of the network studied are rational functions of the frequency variable whose denominators are Bessel polynomials and whose numerators have real frequency roots. Amplitude and group delay characteristics are shown in a set of curves. Transient responses of the networks are investigated for suddenly impressed and removed sinusoidal input signals. The set of curves shows excellent transient behavior compared with that of conventional filters.
Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-12173*# Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
FLIGHT DATA DISPLAY STUDIES FOR REAL TIME COMPUTER FLIGHT EVALUATION Final Report
C. F. Matthews, J. W. Tuttle, and J. C. Flint 25 Sep. 1965 204 p refs
(Contract NAS8-11276)
(NASA-CR-68281; CR-588-137) CFSTI: HC $6.00/MF $1.25 CSCL 14B

This report presents the results of a study of real time displays for monitoring the flight of Saturn launch vehicles. The study was conducted to support the current Saturn I Block II flights, and to study display requirements for future Saturn

IB and Saturn V missions. The data to be displayed, data sources, and formats for display were determined. A general analysis of the display requirements is presented along with specific examples of the application of this analysis to a Saturn I Block II vehicle and a Saturn IB vehicle. The report emphasizes the importance of providing reliable and valid display data and identifies the major factors involved in achieving this capability. R.N.A.

N66-12244*# Boeing Co., Huntsville, Ala.
ADVANCED SYSTEMS CHECKOUT DESIGN First Quarterly Progress Report, Jun. 29–Sep. 29, 1965
29 Sep. 1965 20 p
(Contract NAS8-20240)
(NASA-CR-68102) CFSTI: HC $1.00/MF $0.50 CSCL 22D

The interface between the Saturn vehicle and its support equipment was studied to determine what checkout functions can be performed on-board the Saturn V instrument unit and S-IVB stages. Data on the advanced functional schematics, systems design test, and checkout requirements were used to trace umbilical lines to their source and to identify and catalogue each umbilical wire on the Saturn IB instrument unit. A representative circuit schematic was drawn for each umbilical contained on the S-IVB stage and for 20% of those on the instrument unit. Signal types by connector and signal types by system are presented in two charts. Approximately 40% of the S-IVB stage subsystems was identified and sketched. The S-IVB/IU checkout scheme was defined and gross test requirements for all phases of checkout were identified. G.G.

N66-12279# Federal Aviation Agency, Washington, D. C.
NINETEENTH ANNUAL REPORT OF OPERATIONS UNDER THE FEDERAL AIRPORT ACT, FISCAL YEAR ENDED JUNE 30, 1964
N. E. Halaby 1964 53 p

The activities carried out under the Federal Airport Act are reviewed, and the major changes resulting from an amendment to the Act are outlined. Work done on developing standards for the design, construction, maintenance, and operational safety of airports is also discussed. Tabulations on the Federal Aid Airport Program, and the airports programmed in 1964 are included. M.G.J.

N66-12413* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
INSTITUTE FOR DIRECT ENERGY CONVERSION
Manfred Altman *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 6 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

Some of the problems and concerns of the Institute for Direct Energy Conversion at the University of Pennsylvania are discussed and a few experiences in bringing about the type of an institute which offers all the advantages of identity and yet brings people together to work on interdisciplinary problem areas are related. E.E.B.

N66-12429# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany).
TESTS ON THE TRANSONIC CASCADE TUNNEL. PART 1: INSTALLATION OF THE NACA 7-INCH TRANSONIC CASCADE TUNNEL AT THE DVL, DEVELOPMENT OF INSTRUMENTATION, AND PRELIMINARY TESTS [UNTERSUCHUNGEN AM TRANSONIC-GITTERWINDKANAL. TEIL 1: AUFBAU DER NACA-7-INCH-MESSTRECKE IN DER DVL, ENTWICKLUNG DER MESSANLAGE UND VORVERSUCHE]
W. Heilmann July 1965 47 p refs In GERMAN; ENGLISH Summary
(DLR-FB-65-31) CFSTI: HC $2.00/MF $0.50

So far, predetermination of the flow in compressors and turbines operating with transonic velocities in the blade rows has not been possible, and one has to depend on a limited scope of available measurements. Therefore, the test-section of the 7-inch transonic cascade tunnel, which was made available on a loan basis, has been installed, equipped with new instrumentation, and put into operation. Author

N66-12484# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information.
HOT LABORATORIES An Annotated Bibliography
William E. Bost, comp. Nov. 1965 197 p refs
(TID-3545, Rev. 1) CFSTI: $5.00

This bibliography was prepared as a guide to the literature on design, equipment, and operation of laboratories for work with radioactive materials. The 1286 annotated references are arranged by subject. An author index and a report availability index are given. Author

N66-12487# Joint Publications Research Service, Washington, D. C.
IRRADIATION POSSIBILITIES IN THE 2 KILOCURIE C^{60} RADIATION UNIT AT THE BORIS KIDRIC INSTITUTE AT VINCA
Zorica Draganic 10 Nov. 1965 113 p Transl. into ENGLISH from Tehnika (Belgrade), no. 10, Oct. 1965 / 1852–1857
(JPRS-32813; TT-65-33391) CFSTI: $1.00

A two kilocurie Co^{60} gamma source is described and the possibilities offered by this radiation source are discussed. The use of such sources in chemical synthesis, polymerization, vulcanization of natural and synthetic rubbers, food preservation, and the sterilization of drugs and medical equipment is considered. E.E.B.

N66-12541# Politecnico di Torino (Italy). Laboratorio di Meccanica Applicata.
SOME PROBLEMS ON THE PERFORMANCES AND MEASUREMENTS IN A WIND TUNNEL AT LOW VELOCITY Scientific Report No. 2
Ennio Mattioli Apr. 1965 24 p refs *Its* Tech. Note 26
(Grant AF-EOAR-63-98)
(AFOSR-65-1321; AD-621604)

Experimental researches were begun some years ago in order to study the pressure gradient effect on boundary layer transition along a flat plate. Many inconveniences where encountered: they were concerning the turbulence of the free stream, the measurement of differential pressures and of velocities very low, the interference of noises on the hot wire signal. In this research is shown the study made upon these subjects and the methods used to remove some of the difficulties encountered in order to improve the measurements.
Author (TAB)

N66-12564# Radiation Dynamics, Inc., Westbury, N. Y.
DESIGN AND CONSTRUCTION OF A BAKEABLE SPUTTERING APPARATUS Technical Documentary Report, Nov. 1960–Dec. 1963
Roman Laubert Feb. 1965 62 p refs
(Contract AF 33(616)-8063)
(AL-TDR-64-58; AD-620002)

The construction and testing of an apparatus for studying sputtering is described. The apparatus consists of a duoplasmatron ion source, analyzing magnet, deceleration system, and target chamber. Temperature cycling of the entire system to 400C can be tolerated. The operations of the ion source, analyzing magnet, and deceleration system are described individually and as a system. A target holder bakeable to 400C with two degrees of rotational freedom is described. A short feasibility study is included of an ultra violet ionization source capable of ionizing sputtered atoms. Author(TAB)

N66-12603# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BURNER FOR COMBUSTION OF LIQUID FUELS
I. A. Bronnikov 18 Aug. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 166985 (Appl. No. 814012/24-6 17 Jan. 1963) 2 p
(FTD-TT-6-111/1+2+4; AD-620809)

Object of the invention: Burner for combustion of liquid fuels in industrial furnaces, containing body with nipple for the supply of air, louver for controlling its delivery and two coaxially arranged tubes—inner, having axial displacement, for the delivery of primary atomizer (steam) and outer for the delivery of fuel, characterized by the fact, that for the purpose of improving the quality of fuel atomization and reduce its specific consumption, the output end of the inner tube is provided with a screwshaped turbulator and is situated in front of diffuser, mounted on outer tube. Author(TAB)

N66-12623# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR CONTROLLING A WIND TUNNEL
V. Ya. Mikheyev, V. G. Vasil'yev, M. P. Ryabokon', and V. S. Sukhov 28 Jun. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 145921 (Appl. no. 673460/25, 13 Jul. 1960) 3 p
(FTD-TT-65-202/1+2+4; AD-620092)

The object of the invention is a device for controlling a wind tunnel when investigating models of airfoils, which contains: a control unit for the throttle of the tunnel, a control unit for the change in the angle of incidence of the model, and a control unit for the throttle of the latter, as well as measuring devices of the pressure in the tunnel and in the model and in the angle of turn of the latter. For the purpose of increasing the productive capacity of the tunnel, speeding up the processes of the test, and improving the precision of the results of the measurement, into the indicated units there are programming processes of the test. Author(TAB)

N66-12667# Advisory Group for Aerospace Research and Development, Paris (France).
SIMULATION FOR AEROSPACE RESEARCH
C. W. Harper, ed. Feb. 1964 186 p refs Presented at the 24th AGARD Flight Mech. Panel Meeting, Ames Res. Center, Calif., Feb. 1964
(AGARDograph-99) CFSTI: HC $5.00/MF $1.25

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7. PILOTED SIMULATIONS FOR ATMOSPHERE REENTRY OF SPACE VEHICLES R. C. Wingrove (NASA, Ames Res. Center) p 131–155 refs (See N66-12674 03-11)

8. MIDCOURSE NAVIGATION, GUIDANCE AND CONTROL SIMULATION TECHNIQUES FOR A MANNED SPACECRAFT D. W. Smith (NASA, Ames Res. Center) p 157–187 refs (See N66-12675 03-11)

N66-12668 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOT–VEHICLE SYSTEM SIMULATION
Steven E. Belsley *In* AGARD Simulation for Aerospace Res. Feb. 1964 p 1–32 refs (See N66-12667 03-11) CFSTI: HC $5.00/MF $1.25

A procedure for conducting a meaningful simulation of a pilot–flight-vehicle system is presented and illustrated by various specific examples. The relationship of the various types of simulators to their use is outlined and desirable detailed characteristics are delineated. The tradeoffs (compromises) between simulator complexity, realism and the interrelation of various feedback sensing cues (motion, visual or tactile) are discussed, and the necessity of validating the simulation by use of a variable-stability and variable-control-system aircraft is noted. It is shown that as the problem to be studied becomes more complicated, or the questions asked of the simulation become more quantitative, the simulator characteristics must become more flight-like since, in the last analysis, the best time to ask the question is when the pilot and the vehicle are immersed in the true environment (i.e., flight). Author

N66-12669 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MANNED FLIGHT SIMULATION FACILITIES
John C. Dusterberry In AGARD Simulation for Aerospace Res. Feb. 1964 p 33–59 refs (See N66-12667 03-11) CFSTI: HC $5.00/MF $1.25

Problems in developing manned flight simulators are discussed. Emphasis is placed on providing the pilot with adequate information to judge how well he is performing the prescribed task, and what he must do or how the vehicle or its system may be altered to improve his performance. The operation of a centrifuge with a gimballed cab, a translating table with a gimballed cab, and other miscellaneous motion systems are considered. Methods of processing and presenting the scene are given along with a discussion of outside and inside cockpit visual cues. C.T.C.

N66-12670 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPUTER REQUIREMENTS FOR MANNED AEROSPACE RESEARCH SIMULATION FACILITIES
Robert M. Barnett *In* AGARD Simulation for Aerospace Res. Feb. 1964 p 61–73 refs (See N66-12667 03-11) CFSTI: HC $5.00/MF $1.25

Criteria for selecting computers for manned aerospace research simulation facilities are discussed. The requirements for these facilities are: accurate and stable solutions in time scale

of actual events, versatile input–output communication to other parts of the simulation, convenient communication between the computer and simulation operator, reasonable capacity for growth, and straightforward programming techniques. The basic operation and areas of use are given for the analog, digital, and hybrid computers. These are discussed relative to their use in simulation facilities, and their most advantageous applications defined. C.T.C

N66-12671 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIENCES WITH VISUAL SIMULATION IN LANDING AND TAKE-OFF RESEARCH

Richard S. Bray *In* AGARD Simulation for Aerospace Res. Feb. 1964 p 75–91 refs (See N66-12667 03-11) CFSTI: HC $5.00/MF $1.25

A discussion is given of closed-circuit television visual simulation as applied to studying problems related to the performance, stability, and control in landing and takeoff of various aircraft. Testing techniques, pilot adaptation, and comparisons made with other systems are considered; and areas of application are defined. It is concluded that, given a well presented visual scene of a runway during takeoff, approach, and landing, a research pilot trained and adapted to simulator research can make a valid evaluation of the acceptability of a new aircraft design insofar as critical maneuvers are concerned. C.T.C.

N66-12672 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SIMULATION TECHNIQUES FOR THE STUDY OF V/STOL PROBLEMS

Hervey C. Quigley *In* AGARD Simulation for Aerospace Res. Feb. 1964 p 93–112 refs (See N66-12667 03-11) CFSTI: HC $5.00/MF $1.25

A review is given of some of the recent experiences and techniques used in V/STOL aircraft simulation. Before V/STOL problems can be studied effectively on the flight simulator, the evaluating pilots must be given a realistic demanding task, and adequate motion and visual cues must be made available. It was found that when whole-task simulation is used, motion and/or outside world type visual cues are required along with the standard instrumentation to provide sufficient information to the pilot. Proper cockpit environment and control systems representative of the aircraft being simulated are also required. C.T.C.

N66-12673 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PILOTED SIMULATOR STUDIES OF NEW AIRCRAFT MISSIONS

Glen W. Stinnett *In* AGARD Simulation for Aerospace Res. Feb. 1964 p 113–129 refs (See N66-12667 03-11) CFSTI: HC $5.00/MF $1.25

The use of simulators in studying flight-path-control is briefly described, and the usefulness of cab motion and pilot cues as they apply to the next generation of aircraft is discussed. These include the supersonic transport and the low-level, high-speed, terrain-following tactical fighter bomber. Examples are considered in which airplane handling characteristics were utilized, and the included instrument displays are either under development or evaluation. The function of these displays is to provide the pilot with sufficient information to enable him to perform particular flight-path-control tasks with no outside visual cues. It is shown, however, that providing relevant cab motions is important, even in investigations of instrument displays. C.T.C.

N66-12674 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PILOTED SIMULATIONS FOR ATMOSPHERE REENTRY OF SPACE VEHICLES

Rodney C. Wingrove *In* AGARD Simulation for Aerospace Res. Feb. 1964 p 131–155 refs (See N66-12667 03-11) CFSTI: HC $5.00/MF $1.25

This paper is a review of piloted reentry simulation studies in general research and in support of the X-15 and Mercury projects. Fixed-cockpit simulators have been found to be sufficient for most atmosphere reentry simulation problems. Flight simulations utilizing a centrifuge, wherein the acceleration forces would be impressed in the pilot, have been useful primarily in the familiarization of the pilot to the reentry accelerations and also in the early systems design research. Motion simulators and variable-stability aircraft have been found to be necessary only for control problems. A look at manned entries beyond the X-15 and Mercury programs indicates that simulation studies will involve higher acceleration levels after extended periods of weightlessness with trajectory control problems not yet encountered in flight. Author

N66-12675 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MIDCOURSE NAVIGATION, GUIDANCE AND CONTROL SIMULATION TECHNIQUES FOR A MANNED SPACECRAFT

Donald W. Smith *In* AGARD Simulation for Aerospace Res. Feb. 1964 p 157–187 refs (See N66-12667 03-11) CFSTI: HC $5.00/MF $1.25

Midcourse navigation, guidance, and control of space vehicles are briefly discussed. The navigator tasks for making navigation measurements, performing computer operations, operating and aligning inertial measurement units, and performing midcourse velocity corrections are outlined. The simulation elements necessary to provide information to aid in solution of midcourse problems in these task areas were determined to be: an accurate outside visual scene containing stars, the moon, and earth; a simulated vehicle cab; a computer to simulate the on-board computer; and computers to mechanize the long- and short-period equations of motion of the vehicle and the control-system equations which represent the inertial measurement unit. A direct optical planetarium is shown to provide an accurate outside visual scene for the least cost in the shortest time, and motion and system response requirements are developed for a simulator capable of simulating a wide range of vehicles and control systems. C.T.C.

N66-12852*# Martin Co., Denver, Colo. Aerospace Div.

STUDY OF HOVAIR APPLICATION FOR SATURN Final Report

Sep. 1965 237 p refs

(Contract NAS10-2141)

(NASA-CR-68150; CR-65-23, Vol. II) CFSTI: HC $6.00/MF $1.25 CSCL 22D

A study is presented on the application of Hovair (an air bearing used to support loads at low pressures over relatively smooth surfaces) to Saturn facilities at Kennedy Space Center. The approach to the study is to establish the dynamic characteristics of Hovair pads, based on analytical data, and verified by laboratory tests. A variety of Hovair usages are postulated, and for each of the applications the most practical transporters are conceived and the most promising given detailed evaluations. The evaluations of each application are recorded in terms of technical feasibility, cost, and availability. A structural dynamic evaluation of a Hovair-mounted ML, one of the most promising applications, is included for comparison with the existing crawler transporter system.

C.T.C.

N66-12856*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
MANUAL ATTITUDE CONTROL SYSTEMS, VOLUME II: DISPLAY FORMAT CONSIDERATIONS
R. O. Besco Mar. 1964 53 p refs
(Contract NASw-620)
(NASA-CR-68192; P-64-22) CFSTI: HC $3.00/MF $0.50 CSCL 22D

Experimental simulation studies were conducted to investigate various display parameters and to compare four different formats for the display of spacecraft attitude information. Representative attitude control maneuvers were performed by experienced pilots in a fixed-base spacecraft simulator with kinematic computations performed by an analog computer. Definitions of various display formats and selected attitude display parameters are given. The results of the studies are presented along with suggestions for attitude display design and implications for the selection of display formats. Author

N66-12954# Michigan Univ., Ann Arbor. Dept. of Aeronautical and Astronautical Engineering.
KEWEENAW RESEARCH RANGE
Harold F. Allen Nov. 1964 31 p refs
(Grant MDEE-12)
(Rept.-06595-4-T)

The range is located at the eastern end of the Keweenaw Peninsula in Northern Michigan, with rocket impact areas in Lake Superior. Surface surveillance is accomplished from chartered aircraft, and air surveillance is carried out by the 665th Radar Squadron of the Air Defense Command. Rockets up to Nike-Cajun in performance can be launched from the Range without danger of crossing the international boundary. Higher performance sounding rockets may involve areas in Canadian waters. The range is remote from populated areas, yet easily accessible by all forms of commercial transportation. The climate is mild in summer, severe in winter, with heavy snowfall. It is therefore a good site for environmental tests, winter operational tests, or hazardous experiments. The magnetic field intensity is high and the dip angle is 77° so that it is an excellent place for ionospheric investigations. The location of the range near the center of the North American land mass is important from the standpoint of the Meteorological Rocket Network, or for synoptic measurements of any sort, and for tests requiring a mid-latitude site, or one remote from marine influences. Author

N66-13015*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
POTASSIUM CORROSION TEST LOOP DEVELOPMENT: PURIFICATION AND ANALYSIS OF HELIUM FOR THE WELDING CHAMBER Topical Report No. 1
T. F. Lyon 1 Jul. 1965 48 p refs
(Contract NAS3-2547)
(NASA-CR-54168) CFSTI: HC $2.00/MF $0.50 CSCL 14B

A helium analysis system was assembled and used to measure the concentrations of impurities in a vacuum purged, inert gas welding chamber. The analytical system consists of a mass spectrometer and an electrolytic hygrometer to monitor the chamber gas, and a trace oxygen analyzer and electrolytic hygrometer to detect impurities in the inlet helium. It was found that reliable analyses for water vapor could not be obtained with the initial operation of the mass spectrometer. Since water vapor was expected to be one of the chief contaminants within the welding chamber, the electrolytic hygrometer system was installed on the welding chamber and used for the water analyses. The results indicated that the impurities in the welding chamber (other than water vapor) were oxygen, nitrogen, and hydrogen. The mass spectrometer was then calibrated for these three gases, and the reliable detection limit for each of these was estimated to be between one and two volume ppM. Qualitative analyses of other impurities were also obtained. The layout and operation of the mass spectrometer and other analytical instruments used are described, and typical impurity levels encountered in the welding chamber and changes in the impurity levels are given. R.R.D.

N66-13067# Joint Publications Research Service, Washington, D. C.
AN ALL-METAL MERCURY VAPOR UNIT IN WHICH A 4° 10^{-12}mm CAN BE ACHIEVED
A. B. Tseytlin 6 Dec. 1965 14 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), v. 10, no. 5, Sep.–Oct. 1965 p 177–182
(JPRS-33178; TT-65-33754) CFSTI: $1.00

The article describes the construction of a mercury vapor superhigh vacuum unit and presents the results of the study of its characteristics. It was shown that the limiting vacuum in the unit is determined by the penetration of hydrogen into it due to corrosion of thin walled bellows at the nitrogen outflow leads from liquid nitrogen traps. Elimination of the corrosion of the bellows by coating them with corrosion resistant silicon organic PK-18 enamel enabled improvement of the limiting vacuum in the unit from 10^{-10} to 10^{-12} mm. The rate of pumping in the superhigh vacuum region is determined by the sorption of gas on the cooled surface of the nitrogen trap. Author

N66-13145# Sandia Corp., Albuquerque, N. Mex.
GAS BEARING ATTITUDE CONTROL SIMULATOR
D. R. Schafer Apr. 1965 17 p refs
(Contract AT(29-1)-789)
(SC-TM-65-93)

This memorandum describes a spherical gas bearing attitude simulator. The bearing permits 360 degrees of movement in the roll and pitch axes, and 40 degrees of movement in the yaw axis. The apparatus is used to simulate vehicular motion in frictionless environments which permits optical testing of rocket payload control systems in the laboratory. Author

N66-13218# Martin Co., Orlando, Fla. Physical Sciences Research Lab.
CHARGED PARTICLE ACCELEROMETER First Quarterly Report, 21 May–20 Aug. 1965
O. R. Kyler, F. F. Schloetzer, and W. G. Zinn Sep. 1965 28 p *Its* Tech. Memo. Rept.-1
(Contract NOw-65-0419-c)
(OR-6725; AD-621730)

This report describes the investigations of charged particle accelerometers conducted by Martin-Orlando. The purpose of this program is to develop a charged particle accelerometer capable of sensing linear acceleration. The effort consisted of: (1) evaluation of chamber material on linearity for a three-axis modulated carrier accelerometer; (2) evaluation of heat from light source on internal acceleration; (3) evaluation of photoconductive cells for a dc accelerometer; (4) insertion of particles in a vacuum; and (5) preliminary evaluation on a digital force balance loop. Author (TAB)

N66-13250*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
GROUND SUPPORT EQUIPMENT AND LAUNCH INSTALLATIONS AT JOHN F. KENNEDY SPACE CENTER, NASA, FOR THE MANNED LUNAR LANDING PROGRAM

Rocco A. Petrone [1964] 34 p Presented at the 5th Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964
(NASA-TM-X-57026) CFSTI: HC $2.00/MF $0.50 CSCL 22D

Emphasis is placed on major facilities at launch complex 39 where the mobile concept is being implemented. These include: (1) a vertical assembly building, for assembly and checkout of the space vehicle; (2) a launcher-umbilical tower, where the vehicle is erected vertically for checkout, transfer, and launch; (3) a crawler-transporter, to move the space vehicle and launcher-umbilical tower to the launch pad; (4) an arming tower, to provide space vehicle access at the launch pad; and (5) the launch pad area. The modes of operation of these facilities are discussed, and their relative roles in the manned lunar landing program are included. C.T.C.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-12156*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF A MOMENTUM BUFFER REGION ON THE COAXIAL FLOW OF DISSIMILAR GASES
Robert G. Ragsdale Washington, NASA, Dec. 1965 27 p refs Presented at the AIAA Propulsion Joint Specialists Conf., Colorado Springs, 14–18 Jun. 1965
(NASA-TN-D-3138) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The isothermal mass and momentum transfer that occurs when a heavy slow moving gas is injected coaxially into a duct of light fast moving gas was studied. The outer stream is composed of an outermost region moving at high velocity, and an annular sheath of intermediate velocity adjacent to the central core. As a basis for comparison, the total mass flow rate of outer fluid is held constant; thus, as the buffer region velocity is decreased, the velocity of the remaining outer region is increased. The effects of velocity and thickness of this buffer region on the mixing of the two fluids are investigated for both laminar and turbulent flow. Outer to inner fluid velocity ratios of 10, 50, and 100 are considered. The effect of a momentum buffer region is presented in terms of the amount of inner stream fluid contained within a specified length of the outer duct. Results show that optimum values of buffer velocity and thickness exist which give a maximum amount of inner fluid in a given length of duct. Optimum velocity is greater for turbulent flow than for laminar flow. Optimum thickness is independent of whether the flow is laminar or turbulent. The optimum buffer thickness is about 1 inner stream radius. The presence of a buffer region increases the amount of inner gas contained in a duct length of 2 initial jet diameters by more than a factor of 2. R.N.A.

N66-12190*# Southwest Research Inst., San Antonio, Tex.
SUBHARMONIC OSCILLATIONS IN AN ARBITRARY AXISYMMETRIC TANK RESULTING FROM AXIAL EXCITATION Technical Report No. 5
Wen-Hwa Chu Sep. 1965 66 p refs
(Contract NAS8-11045)
(NASA-CR-68161) CFSTI: HC $3.00/MF $0.75 CSCL 20D

The problem of subharmonic liquid response in a container subject to vertical, axial excitation has been solved to the second approximation by the method of perturbation, employing characteristic functions. Application of the integral equation method has been made so that numerical construction of the Neumann function and the characteristic functions is possible, at least, for convex axial symmetric tanks. The method can be easily extended to determine the liquid response in an arbitrary tank but its limitation depends on the size of the computer, the accuracy desired, and the cost involved. Author

N66-12278# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
NOTES ON EXPERIMENTAL WORK IN JET IMPINGEMENT AND ON TURBULENCE IN VORTICES
E. W. Graham Apr. 1964 14 p refs
(TM-32)

Suggestions concerning experimental jet impingement studies are presented for such problems as determination of critical obstacle heights for recirculation; low obstacles; flow pattern turbulence; test equipment flexibility; and wind-generated recirculation. Comments are also included on the use of diffusors in alleviating downwash impingement problems. The distribution and instability of turbulence in vortices are considered, and equations are derived for determining the frictionless stability for vortex flow, and for a simplified vortex stability problem. M.G.J.

N66-12393# RAND Corp., Santa Monica, Calif.
ALTERNATIVE TECHNIQUES FOR THE INVARIANT IMBEDDING OF RAREFIED COUETTE FLOWS
J. Aroesty, R. Bellman, R. Kalaba, and S. Ueno Aug. 1965 21 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-3773-ARPA; AD-621657)

The Memorandum re-examines the application of invariance techniques to plane Couette-flow problems and presents several different approaches to the derivation of the invariant-imbedding equations. It is shown how both linear and nonlinear collision operators may be considered, for both discrete and continuous versions of the original Boltzmann formulation. Author (TAB)

N66-12439# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany).
TWO-DIMENSIONAL SUPERSONIC FLOW WITH RELAXATION [EBENE STROMUNG MIT RELAXATION]
Fritz Bartlma Jul. 1965 32 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-34; DVL-442) CFSTI: HC $2.00/MF $0.50

Supersonic wind-tunnel expansions occur so rapidly that thermodynamic equilbrium cannot set up. During expansion the water vapor in the air is supercooled, and the supersaturated state suddenly collapses on a short distance in flow direction. The disturbance marking the collapse is customarily called a condensation shock. A two-dimensional treatment of this process by the method of characteristics is presented as an example for the motion of a relaxing gas. Author

N66-12535# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN EXPLORATORY STUDY OF OPEN WAKE EFFECTS UPON THE PRESSURE DISTRIBUTION OF A HYPERSONIC BODY
George Eugene Thompson (M.S. Thesis) Aug. 1964 70 p refs
(GA/AE/64-2; AD-621430)

High base pressures have resulted in the formation of separation regions on hypersonic bodies. To investigate this occurrence, air was injected against a small flat plate in the wake region of an axially symmetric ellipsoid, and the boundary layer was separated. The tests were conducted in a four-inch hypersonic wind tunnel at Mach numbers of 14 and 17. It was concluded that the effects from side mounted stings were the most probable cause of open wakes. It was necessary to increase the Reynolds number with increasing Mach number if an open wake was to be avoided. Two conditions of laminar boundary layer stability were encountered: One stability condition produced a free-interaction between boundary layer separation and reattachment, while the more stable condition always produced a strong interaction between them. It was noted that the model temperature necessary for the increased stability phase of a laminar boundary layer, decreased with increasing Mach number. The method of air injection used is a simple and effective means by which the boundary layer-shock wave interaction can be investigated along the length of a body. Author (TAB)

N66-12544# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
HORIZONTAL OSCILLATIONS OF FALLING SPHERES Final Report
Uri Shafrir 1 Feb. 1965 43 p refs
(Contract AF 19(628)-3993)
(AFCRL-65-141; AD-621741)

Experiments with solid spheres with diameters of 3/16 in. to 14/16 in. and specific gravities in the range of 1.14 to 14.95 gm/cc, falling in distilled water at 20–24 C were carried out. With the aid of a stereophotographic-strobe technique, the time resolved, three dimensional trajectory of each sphere was recorded. Analysis of the trajectories revealed the existence of horizontal oscillations of a falling sphere, with amplitude and wave length depending to some extent on the Reynolds number. Author (TAB)

N66-12557# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODOLOGY FOR THE CALCULATION AND MEASUREMENTS RELATIVE TO THE MIXING OF GASES
B. S. Stechkin 6 Aug. 1965 7 p Transl. into ENGLISH from Tr. Inst. Dvigateley, Akad. Nauk SSSR, no. 6, 1962 p 138–139
(FTD-TT-65-951/1+2; AD-619437)

The mixing of two streams of incompressible liquid, with cross section velocities w_1 and u_1 in one portion and identical velocities w_2 in another portion of a mixing chamber, is considered. The friction along the walls of the mixing chamber was neglected since the main role for determining loss was played by losses due to mixing. A mathematical equation indicated that losses during mixing could have been determined according to the Borda–Carnot theorem. It was noted that the lost kinetic force was equal to the kinetic portion of the loss and acquired velocity of the mixing streams. R.W.H.

N66-12558# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SHOCK LAYER METHOD IN PROBLEMS OF HYPERSONIC FLOW OVER THIN BLUNTED BODIES
V. V. Lunev 6 Aug. 1965 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1962 p 146–147
(FTD-TT-65-935/1; AD-619435)

Comments are presented for calculating the flow past thin blunt bodies using the shock wave method. From the disturbed region, a high entropy layer of thickness δ was separated, formed by the gas having passed through a shock wave of great intensity with an angle of inclination $\epsilon \sim 1/2\,\pi$ passing out from the blunting. Since the density in this layer was low, the pressure $p \infty U^2$ p across was considered constant. R.W.H.

N66-12560# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTERACTION OF THE BOUNDARY LAYER WITH AN EXTERNAL FLOW CAUSED BY RADIATIVE HEAT TRANSFER
V. V. Lunev and A. N. Rumynskiy 9 Aug. 1965 22 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), v. 7, no. 6, 1961 p 44–53
(FTD-TT-65-958/1+2; AD-620863)

The laminar boundary layer on the surface of a wedge streamlined by a hypersonic flow of radiative gas is studied with the assumption that the effect of radiation on gas flow in the disturbed region is small. It is assumed that gas radiation is independent of its motion in front of the density shock. Only that range of temperatures where the radiation pressure and density of radiant energy may be neglected is considered. In order to separate the effect of interaction of the boundary and shock layers brought about by radiant heat exchange the boundary layer is considered to be thin and the effect of its displacement thickness on the shape and parameters of the shock wave is neglected. The temperature of the wedge surface Tw, the Prandtl number P and the product of gas viscosity times its density are taken constant. TAB

N66-12561# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE APPLICABILITY OF A MONODIMENSIONAL MODEL IN DESCRIBING THE STATIONARY FLOW OF A VISCOUS INCOMPRESSIBLE LIQUID IN A CYLINDRICAL PIPE WITH PERVIOUS WALLS
B. A. Rayzberg and K. P. Samsonov 18 Jun. 1965 7 p refs Transl. into ENGLISH from Inzh. Zh (USSR), v. 4, no. 1, 1964 p 127–129
(FTD-TT-65-318/1+2+4; AD-620811)

Flow of liquid in pipes is usually described on the basis of a monodimensional system. The irregularity in the distribution of hydrodynamic flow parameters in transverse section is considered the introduction into equation of motion of coefficients, the magnitude of which depends upon the flow condition of the liquid. In this report the possibility is analyzed of such an approach to a stable flow in a cylindrical pipe with porous walls, through which the liquid is fed. TAB

N66-12569# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INVISCID VELOCITY PROFILE PRODUCED BY AN AXISYMMETRIC CONTOURED NOZZLE FOR AN ARC-HEATED HYPERSONIC WIND TUNNEL
Thomas Laurence Larsen (M.S. Thesis) Jun. 1965 80 p refs
(GAM-65B/ME/65-5; AD-620827)

The study experimentally investigated equilibrium and non-equilibrium flow at the exit of a 9 1/2 inch diameter axisymmetric contoured hypersonic nozzle. The flow was probed with an impact pressure probe, and steady state and transient calorimeters, and the velocity was calculated from these data. The shape of the resulting velocity profiles showed that the nozzle produced uniform parallel flow, and that the nozzle design method was adequate for use in desigining a 5.5 foot diameter

contoured nozzle to produce equilibrium flow up to Mach 10 and non-equilibrium flow at Mach numbers of 11–15 in an arc-heated hypersonic tunnel. Author (TAB)

N66-12575# New York Univ., N. Y. AEC Computing and Applied Mathematics Center.
FINITE DIFFERENCE CALCULATIONS FOR HYDRODYNAMIC FLOWS CONTAINING DISCONTINUITIES
Samuel Z. Burstein Sep. 1965 45 p refs
(Contract AT(30-1)-1480)
(NYO-1480-33)

The steady hypersonic inviscid flow around a blunt body, including a detached shock, is calculated. The steady flow is obtained as the limit for time dependent flow starting with plane flow impinging on the body. The transient flow is the solution of a mixed initial boundary value problem for the partial differential equations of inviscid fluids which is solved by a difference scheme proposed by Lax and Wendroff. Calculations show that this difference scheme tends to be unstable and does not converge to the steady flow. The calculation was stabilized by adding an artificial viscosity term. A convincing theoretical explanation of this stabilizing effect is given and a new stability condition is derived. Both plane and cylindrical symmetries are considered. In the cylindrical case, a variant of Rechtmyer's two step version of the Lax-Wendroff difference scheme is used. This method requires fewer arithmetic operations as compared to the one step method. R.N.A.

N66-12598# Columbia Univ., New York. Plasma Lab.
A KINETIC-THEORETIC DESCRIPTION OF SHOCK WAVE FORMATION
C. K. Chu Feb. 1965 29 p refs *Its* Rept.-16
(Contract AF 49(638)-1254)
(AFOSR-65-1267; AD-621200)

This paper extends the method and results previously obtained for shock waves in 1-dimensional gas to a monatomic 3-dimensional gas. The classical Riemann problem—the flow of a gas in a shock tube—is treated as an initial value problem for the Krook equation, after the Krook equation is first reduced to two simultaneous Krook equations each for a 1-dimensional gas. Results are obtained on the formation of shocks corresponding to Mach numbers of 1.27, 1.5, and 1.75. It is seen that the stronger the shock, the shorter the formation time. The short time behavior of the flow agrees with free flow, while the long time behavior agrees with fluid dynamics. Author (TAB)

N66-12648 Library of Congress, Washington, D. C. Aerospace Technology Div.
A NEW METHOD FOR SOLVING LAMINAR BOUNDARY-LAYER PROBLEMS
Victor Klein *In its* Foreign Sci. Bull., Vol. 1, No. 11, Nov. 1965 p 29–32 refs (See N66-12644 03-34)

A method is presented for solving problems in the laminar boundary-layer theory. A universal equation for the given particular problem is derived, and from this equation the required boundary-layer parameters are determined by relatively simple calculations. The necessary values of nondimensional arguments are taken from special tables, thus making the numerical integration of the boundary-layer equations unnecessary for this particular problem. Author

N66-12758# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
REDUCTION OF DRAG IN TURBULENCE BY DILUTE POLYMER SOLUTIONS
Hyunkook Shin (Ph.D. Thesis) Jun. 1965 317 p refs
(Nonr-3063(10))
(AD-619711)

The object of this thesis was to investigate the drag reduction phenomenon in turbulent flow caused by random coiling macromolecules in 'dilute' solution. In particular, this thesis was concerned with the relationship of drag (or its reduction) to the size of the coils and their concentration, of two kinds of polymers differing significantly in chain flexibility: polyethylene oxide (PEO), the more flexible, and polyisobutylene (PIB), the less flexible. It was found that, within any given homologous polymer series, the ability of macromolecules to reduce drag improved drastically with increasing molecular weight. That is, the concentration of polymers in solution either in the absolute weight fraction or in the effective volume fraction required to yield a given percent drag reduction decreased rapidly with increasing molecular weight. It was further found that there always existed an optimum concentration for any given polymer system at which the observed drag reduction reached a maximum. TAB

N66-12809# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
SOME PHYSICAL CONSIDERATIONS OF THE HYDRODYNAMIC STABILITY OF PARALLEL FLOWS OF A DUSTY GAS
J. T. C. Liu Jul. 1965 33 p refs
(Contract AF 49(638)-1271)
(Rept.-745; AD-622565)

Some of the physical implications of the stability of parallel flows of a dusty gas are studied. The energy balance of such a disturbed flow shows that the increase or decrease of the overall (gas plus particle) disturbance kinetic energy depends upon the relative magnitude of (1) energy dissipation due to the usual gas viscosity and augmented by the work done due to particle-gas interaction, and (2) energy conversion from the mean flow to the disturbances by both the gas and the particle Reynolds shear stresses. The viscous sublayer structure, where viscosity is known to be destabilizing, is deduced. It is shown that augmented phase shift of the gas velocity components, due to particle-gas interaction, tends to decrease the gas Reynolds shear stress but is eventually offset by their relative magnitude increase. TAB

N66-12816# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INVESTIGATION OF THE MIXING REGION BETWEEN THE PRIMARY AND SECONDARY STREAMS OF A TWO-DIMENSIONAL SUPERSONIC AIR–AIR EJECTOR SYSTEM
James R. Nelson (M.S. Thesis) Jun. 1965 92 p refs
(GAM-653/ME/65-6; AD-621018)

The turbulent mixing region of a two-dimensional, supersonic, air–air ejector system was experimentally investigated utilizing an interferometer. Density distributions for the two-stream mixing region within the ejector duct were established for 6 different test configurations. Similarity of the density distributions was indicated for mixing region cross sections as close as one nozzle exit hydraulic diameter from the nozzle. Density profiles at successive downstream duct locations were plotted to show the spread of the mixing region. The effect of normal and oblique shocks on the rate of spread of the mixing region was found to be small. In addition, ejector performance data and techniques for spark lamp photography are presented. It is concluded that the interferometer could be effectively utilized to help determine the transport coefficients of ejector system turbulent mixing processes. Author (TAB)

N66-12818# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
HEAT TRANSFER, NORMAL STRESS, AND SHEAR STRESS FOR A FREE-MOLECULAR GAS IMPINGING ON SEVERAL WALL MODELS
Harold L. Rogler (M.S. Thesis) Mar. 1965 144 p refs
(GAM-65A/AE/65-3; AD-621451)

An analytical study of gas-surface interactions was made in a free-molecular flow; perfectly elastic collisions between the billiard-ball molecules and the surface were assumed and the molecules were governed by a Maxwellian velocity distribution in the free-stream. Normal stress for specular reflection from a stationary boundary was increased as the square of the mass velocity normal to the boundary, while the mass velocities tangential to the boundary had no influence on the normal stress. Normal stress increased as the square of the wall velocity, when the wall velocity squared was small as compared to the local mean square random velocity. Energy was transferred into the gas as a function of the wall speed to the second and fourth powers. Pressure and heat transfer were independent of the vibration frequency. Throughout the study, energy transfer, shear stress, and normal stress were shown to be directly dependent on gas density and the mean-random velocity. TAB

N66-12842# RAND Corp., Santa Monica, Calif.
ON CONCAVE BODIES IN FREE MOLECULE FLOW
R. Schamberg May 1965 31 p refs
(P-3164; AD-621958)

Work by M. T. Chahine on aerodynamic forces and heat transfer for free molecule flow past concave bodies is summarized. His numerical results are presented in an alternate form which is more conducive to physical understanding of the flow and generalization to other geometries. TAB

N66-12848# New York Univ., N. Y. Research Div.
THE APPLICATION OF A PERTURBATION TECHNIQUE TO THE NONLINEAR EQUATIONS OF INTERNAL WAVE MOTION AND A COMPARISON OF THE RESULTANT THEORETICAL WAVE FORMS WITH THOSE OBSERVED IN NATURE
Clement A. Griscom Sep. 1965 65 p refs *Its* Geophys. Sci. Lab. Rept.-65-8
(Contract Nonr-285(57))
(AD-622224)

A short history is given of the past and current work on internal waves. Time histories demonstrating the effect of thermocline depth on internal wave configuration in shallow water are discussed. Other records on internal wave configurations in deep water are discussed also. A simplified two-layer model is constructed, and a perturbation expansion is carried out for the basic nonlinear equations governing wave motion at the interface of the fluids in order to get the second order correction to the equation for the internal wave profile. Second order profiles are discussed which depend on simplifying assumptions concerning layer depths, density differences, and wavelengths. Also second order profiles are constructed for the shallow water examples which show good agreement with the data presented. These latter profiles are based on numerical analyses of the second order terms. Author (TAB)

N66-12861*# Alabama Univ. Research Inst., Huntsville.
HYPERSONIC FLOW OF AIR PAST A CIRCULAR CYLINDER WITH NON-EQUILIBRIUM OXYGEN DISSOCIATION INCLUDING DISSOCIATION OF THE FREE STREAM
Rudolf Hermann and Jurgen Thoenes Sep. 1965 42 p refs Presented at the 6th European Aeron. Congr., Munich, 1–4 Sep. 1965
(Grant NsG-381)
(NASA-CR-68238; UARI-RR-28) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Hypersonic, chemically relaxing inviscid flow of air past a circular cylinder has been calculated using Dorodnitsyn's method of integral relations. Considered are the effects of non-equilibrium oxygen dissociation on the distribution of the flow variables in the subsonic and supersonic region of the shock layer. Also investigated is the influence of oxygen dissociation in the free stream on the shock detachment distance and the flow field in general. Particular emphasis has been placed on the investigation of the flow along the stagnation streamline, which indicates the existence of an equilibrium region in front of the body. The results show that the shock wave, at fixed free stream composition, moves closer to the body with increasing free stream Mach number, that is with larger oxygen dissociation behind the shock. However, increasing oxygen dissociation in the free stream, at otherwise fixed free stream conditions, pushes the shock wave away from the body. Author

N66-12877# General Electric Co., Philadelphia, Pa. Missile and Space Div.
CORRELATION OF NONEQUILIBRIUM CHEMICAL PROPERTIES OF EXPANDING AIR FLOWS
C. J. Harris and Walter B. Warren Dec. 1964 17 p refs
(Contract AF 40(600)-1091)
(R64SD92; AD-621857)

A correlation was presented which permits characterization of the chemical properties of air in the expanding nonequilibrium flow of a hypersonic aerodynamic test facility. This is a correlation of the non-equilibrium concentrations of the N_2, O_2, N, O and NO species in terms of reservoir entropy (S/R). The species concentrations are defined and are presented in units of moles per gm. of mixture. This correlation with entropy is for air expanding from a wide range of reservoir or stagnation enthalpy (H/RT_0 = 72 to 720) values to a nozzle area ratio (A/A^*) value of 103. The gas composition at $A/A^* = 1.000$ was determined from existing numerical computations. The reservoir entropy correlation approach is also used to define a 'percentage oxygen dissociation criterion' for the expanding flow. This criterion is then compared to previously published 'departure from equilibrium' and 'freezing' criteria. The performance of existing and proposed hypersonic and hypervelocity test facilities is considered in the context of the foregoing correlation and criteria. As an example of such facilities, an MHD augmented shock tunnel is considered in particular. Author (TAB)

N66-13014# Advisory Group for Aerospace Research and Development, Paris (France).
THE THEORY OF HIGH SPEED GUNS
Arnold E. Seigal (Naval Ordnance Lab.) May 1965 326 p refs
(AGARDograph-91)

This monograph summarizes the gas dynamics of high-speed guns, utilizing a gas of low molecular weight at high temperature. Theory and test results are presented. The reader is assumed to be an advanced student in engineering. The fundamental ideas and equations are fully developed. Author

N66-13050*# National Aeronautics and Space Administration, Washington, D. C.
STREAMLINES IN A CONTINUOUS FLOW [LIGNES DE COURANT D'UN ECOULEMENT CONTINU]

Robert Legendre Dec. 1965 18 p refs Transl. into ENGLISH from Rech. Aerospatiale (France), no. 105, 1965 p 3-9 (NASA-TT-F-405)

The author states some tentative principles in the absence of an existence theorem of sufficiently general solutions of viscous fluid equations which could be applied by engineers. These principles are used for the characterization of the singular points of flow, which can be determined and identified by experimental engineers to solve a problem of fluid mechanics by a model. Author

N66-13079*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
ANALYSIS OF UNSTEADY INCOMPRESSIBLE FLOW OUT OF DIFFERENT TANK CONFIGURATIONS
H. H. Seidel Mar. 1964 14 p refs
(Contract NAS8-5289)
(NASA-CR-68406; R-92) CFSTI: HC $2.00/MF $0.50 CSCL 20D

An analysis was made in order to find the flow rates and position of liquid levels in tanks when they are drained by gravity. During this process unsteady flow occurs and a given steady flow cannot be assumed any more. Samples for one-tank and two-tank configurations are brought up with and without hydraulic losses in the lines. The results are differential equations which can be solved numerically by a digital computer. Author

N66-13162*# California Univ., Berkeley. Space Sciences Lab.
MEASUREMENTS OF MASS AND MOMENTUM FLUX IN NON-IDEAL MOLECULAR BEAMS
R. G. Lord and F. C. Hurlbut 12 Feb. 1965 47 p refs
(Grant-NsG-243-62; Contract Nonr-222(45))
(NASA-CR-68538) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Molecular beams formed by effusion through an orifice whose size is of the same order as the mean free path in the source chamber are non-ideal in the sense that the effects of intermolecular collisions in the beam are not negligible. The properties of such beams have been investigated by measuring, over a wide range of source conditions, the normal momentum transferred from the beam to a diffusely reflecting test surface mounted on a sensitive torsion balance. The perturbation of the measured force on the test surface from its ideal free molecule value is interpreted in terms of the mass and momentum flux perturbations in the beam and compared with the predictions of recent theories. A substantial discrepancy is noted between the calculated and measured perturbations. These experiments have demonstrated the feasibility of making absolute measurements of momentum transfer in particle-surface interactions. Author

N66-13212# ARO, Inc., Arnold Air Force Station, Tenn.
ALTITUDE-VELOCITY TABLE AND CHARTS FOR IMPERFECT AIR. VOLUME II: NORMAL SHOCK-WAVE GAS COMPOSITION DATA
Clark H. Lewis and E. G. Burgess, III Arnold Eng. Develop. Center, Nov. 1965 164 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-65-232, Vol. II; AD-473333)

Gas composition data are given based on the 28-specie air model used by Hilsenrath and Klein and corresponding to the altitude-velocity table and charts of Lewis and Burgess and the 1962 U.S. Standard Atmosphere. The data as functions of altitude and velocity are presented in three parts as follows: free-strean stagnation gas composition data, normal shock-wave gas composition data, and normal shock stagnation gas composition data. Comparisons are made with previous perfect gas results based on a 14-specie air model and the ARDC 1959 Model Atmosphere. Relative differences in some species as large as 45 percent were found for the limited comparisons presented. Author

N66-13232*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRESSURE FLUCTUATIONS IN TURBULENT BOUNDARY LAYERS
M. V. Lowson (Wyle Labs., Huntsville, Ala.) Washington, NASA, Dec. 1965 31 p refs
(NASA-TN-D-3156) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The equations governing the pressure fluctuations in a turbulent boundary layer are derived following the known methods for incompressible flow. The attached turbulent boundary layer is discussed, and the hypothesis is advanced that the major cause of wall pressure fluctuations is the intermittent eruption of the laminar sublayer observed during flow visualization experiments. The separated turbulent boundary layer is also discussed. Compared to the attached boundary layer, the equations already derived show how additional sources of pressure fluctuations may be present in the separated boundary layer. First, the "turbulence-turbulence" interaction terms may be important, and second, it is shown how additional pressure fluctuations can arise from the interaction of the turbulence with the gradients of velocity in the free stream direction. Finally, it is shown how the conventional turbulence-mean shear interaction gives rise to pressure patterns which are convected at only a fraction of the free stream velocity. Since this conclusion contradicts the presently available supersonic experimental results, additional mechanisms of pressure fluctuation may be occurring in supersonic separated flow. Author

N66-13237*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID CAVITATION STUDIES IN CIRCULAR PIPE BENDS
R. E. Stonemetz Washington, NASA, Dec. 1965 24 p refs
(NASA-TN-D-3176) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Incipient cavitation indices were determined for bends of 60°, 90°, and 120° in one plane for pipe diameters (d) of 1.5, 2.0, and 4.0 inches, and bend radius ratios (R/d) of 0.7, 1.0 and 1.5. The working fluid was water. It was found that, for all configurations investigated, the critical cavitation index decreased somewhat with increasing values of Reynolds number and ratio of the fluid vapor pressure to the upstream dynamic pressure. The critical cavitation index was greater for smaller ratios of bend radius to pipe diameter. The bend angles investigated, 60°–120°, had insignificant effect. An empirical relationship was derived for the determination of the critical cavitation index. This relationship takes into account the effects of bend radius and pipe diameter. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-12172*# National Bureau of Standards, Washington, D. C.
IONOSPHERIC SOUNDINGS FROM MOBILE LAUNCH PLATFORM Final Report

[1965] 2 p
(NASA Order R-148)
(NASA-CR-68280) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Some 8,000 individual ionospheric radio soundings were obtained during the ship's course, and a complete series of ionospheric f-plots was prepared. An outline of the equatorial magnetometer program of higher atmospheric probes is given, in which the presence of an electrojet may be correlated with the equatorial sporadic E observed by ionosonde. Ship based airglow photometer measurements in the vicinity of the magnetic equator and the sub-equatorial anomaly were correlated with high electron densities. Analsyses of the equatorial anomaly latitude variation, the occurrence of equatorial sporadic E, the latitude behavior of the F-1 layer, and interferences concerning the connection of neutral atmospheric movements with ionosphere variations are in progress. G.G.

N66-12187*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
DIRECT MEASUREMENTS IN THE IONOSPHERE Final Report
Andrew F. Nagy Oct. 1965 8 p refs *Its* Rept.-05671-6-F
(Contract NASr-54(04))
(NASA-CR-68095) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Ionospheric electron temperature and density data from sounding rockets carrying Langmuir probes, were evaluated. Daytime electron temperature profiles were compared to radar backscatter measurements. Higher than usual standard deviations of the data points were due to the high spin rate of the rocket. Electron temperature results from a night flight are also presented graphically. G.G.

N66-12248*# Geophysics Corp. of America, Bedord, Mass. GCA Technology Div.
EXPERIMENTAL AND THEORETICAL STUDIES IN PLANETARY AERONOMY Final Report
F. F. Marmo Apr. 1965 133 p refs
(Contract NASw-840)
(NASA-CR-68106; GCA-TR-65-16-N) CFSTI: HC $4.00/MF $1.00 CSCL 04A

Detailed technical summaries are presented of published reports generated by investigations of the photochemistry of planetary atmospheres, theoretical studies, experimental studies in the vacuum ultraviolet (VUV) and extreme ultraviolet (EUV) spectral regions, and theoretical aeronomy. The approach employed is discussed, and pertinent tables, figures, and data analyses are included. Brief summaries are also presented on other phases of the continuing research effort to indicate the level of the research, the scope of the work involved, and the scientific direction and approach of future investigations. M.G.J.

N66-12257*# National Aeronautics and Space Administration, Washington, D. C.
ENERGY TRANSFORMATION IN THE ATMOSPHERE OF THE NORTHERN AND SOUTHERN HEMISPHERES AND INTERACTION OF PROCESSES IN BOTH HEMISPHERES [PREOBRAZOBANIYE ENERGII V ATMOSFERE SEVERNOGO I YUZHNOGO POLUSHARIY I VZHIMODEYSTVIYE PROTESSOV V OBOIKH POLUSHARIYAKH]
Ye. P. Borisenkov Dec. 1965 15 p refs Transl. into ENGLISH from Meteorol. Issled. (Moscow), no. 9, 1965 p 5–13
(NASA-TT-F-396) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Seasonal variability of potential and kinetic energy in the atmosphere of the Northern and Southern Hemispheres at different latitudes is considered. It is shown that seasonal transformations of energy in both hemispheres substantially differ due to the nature of underlying surface. The necessity of the interaction of processes in both hemispheres is based on the study of kinetic energy of the zonal atmospheric motion. It was concluded that the atmospheric processes in the Northern and Southern Hemispheres are a single mechanism of circulation and cannot be studied separately. Author

N66-12260*# National Aeronautics and Space Administration, Washington, D. C.
PROCESSES IN THE STRATOSPHERE BASED ON ROCKET SOUNDING DATA [PROTSESSY V STRATOSFERE PO MATERIALAM RAKETNOGO ZONDIROVANIYA]
L. A. Ryazanova and I. A. Khvostikov Dec. 1965 9 p refs Transl. into ENGLISH from Meteorol. Issled. (Moscow), no. 9, 1965 p 58–63
(NASA-TT-F-399) CFSTI: HC $1.00/MF $0.50 CSCL 04A

This paper presents characteristic features of the temperature regime in the stratosphere revealed mainly by analysis of rocket sounding data carried out by the USSR during the IGY. These are: types of thermal stratification, features of annual temperature variation, thermal regime in the upper stratosphere during the Arctic polar night, and possible causes leading to the formation of temperature inversion. Author

N66-12318# St. Louis Univ., Mo.
THE TRANSFER FUNCTION FOR P-WAVES FOR A SYSTEM CONSISTING OF A POINT SOURCE IN A LAYERED MEDIUM Scientific Report No. 12
Karl Fuchs Bedford, Mass., AFCRL, Jul. 1965 64 p refs (Contract AF 19(604)-7399; ARPA Order 292; Proj. Vela Uniform)
(AFCRL-65-526; AD-621715)

This paper investigates in what manner the spectrum of body waves radiating from point sources in a multilayered medium over a homogeneous half-space is different from the spectrum of body waves from the same source in an infinite medium. The effect of the system consisting of a point source in a layered crust on the spectrum of p-waves observed at large distances in the half space is studied. Analytical expressions for the transfer function of this system are derived for three types of point sources: an explosive source, a single couple, and a double couple of arbitrary orientation within the crust. Preliminary numerical computations for the explosive source at various depths in a realistic model of the earth's crust study of the effect of: (a) the angle of incidence into the homogeneous half-space, (b) the source depth, (c) minor variations of the crustal model. In the case of an explosive source the most influential parameter of the transfer function is the source depth. In shallow explosions the low frequency part of the spectrum of body waves is comparatively rejected. Author (TAB)

N66-12384 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF DIGITAL COMPUTERS FOR AEROTRIANGULATION
A. N. Lobanov 15 Sep. 1965 24 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 11, 1958 p 29–42
(FTD-TT-65-380/1+2; AD-621736)

The aim of aerotriangulation is to find by aerial photographs the geodetic coordinates of points on the ground. This general problem may be separated into three individual ones: (1) determination of elements of reciprocal orientation of aerial photographs; (2) plotting of the ground model, i.e., calculation of

photogrammetric coordinates of ground points; and (3) outer orientation of the model by reference marks, i.e., calculation of geodetic coordinates of ground points. TAB

N66-12368 Joint Publications Research Service, Washington, D. C.
THE CURRENT TRENDS IN HYDROGEOLOGY AND PROSPECTS FOR FUTURE DEVELOPMENT
Ta-Ch'un Wang and Tsung-Hu Chang *In its* Transl. on Communist China's Sci. and Technol., No. 234 8 Nov. 1965 p 1–19 (See N66-12367 03-34) CFSTI: $3.00

The investigation and research of regional hydrogeology to discover the deposits and distribution of water bearing strata and their supply, as well as their flow and expulsion rates are reviewed. Other subjects discussed are: (1) the dynamics of ground water; (2) the balance of ground water movement and its control; (3) the development and maintenance of ground water resources; (4) the hydrogeology of mine beds; and (5) hydrochemistry and mineral water. R.R.D.

N66-12369 Joint Publications Research Service, Washington, D. C.
THE PRESENT AND FUTURE DEVELOPMENT TREND OF ENGINEERING GEOLOGY
Tsung-Yu Chang and Ta-Shun Wang *In its* Transl. on Communist China's Sci. and Technol., No. 234 8 Nov. 1965 p 20–37 (See N66-12367 03-34) CFSTI: $3.00

Continued improvement in the technical methods of exploration and experimentation to solve engineering geology problems are discussed. The areas covered include: (1) research on basic soil characteristics, including soil composition, structure, physical characteristics, hydraulic characteristics, and physical-chemical characteristics; (2) the physical characteristics of hard and semihard rock; (3) the stability of slopes; (4) the stability program of building foundations, especially large buildings; (5) research on the Karst growth rule and related engineering geology problems; (6) the compilation of maps; and (7) prospecting techniques of engineering geology. R.R.D.

N66-12388# Control Equipment Corp., Needham Heights, Mass.
STUDY OF THE CHEMISTRY OF THE EARTH'S UPPER ATMOSPHERE Final Report, 1 Jun. 1964–31 May 1965
Harry E. Adams Jun. 1965 14 p
(Contract AF 19(628)-4201)
(AFCRL-65-576; AD-621753)

A summary is given of work involving the study of the chemistry of the upper atmosphere and the kinetics of atmospheric gases. The work included design, construction, test and installation of instrumentation in rocket and satellite payloads and in laboratory devices; the performance of field and laboratory studies; and the evaluation of experiment results. The work was divided into three separate programs as follows: (1) Studies of the density, pressure, and temperature of the earth's upper atmosphere; (2) Studies of the composition of the earth's upper atmosphere; (3) Studies of the reaction rates of neutral and ionized species. TAB

N66-12391# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
LEAST SQUARES REDUCTION OF BOTTOMSIDE IONOGRAMS Scientific Report No. 246
Joseph M. Grebowsky 15 Aug. 1965 68 p refs
(Contract AF 19(628)-4014; Grant NSF GP-2914)
(AFCRL-65-669; AD-621908)

Techniques are presented by which the distribution of electrons in the bottomside ionosphere can be determined using bottomside ionograms. These methods are based upon a least squares solution of the virtual height equations. Using an iterative minimization scheme, the electron density profile can be approximated by a given functional form. For this type of analysis ordinary and/or extraordinary mode data are used. Similarly, if the retardation due to the lower portion of a layer is known, the same minimization scheme can be used to approximate the nose of a layer by a parabola using virtual heights sampled near the peak plasma frequency. For the situation in which the virtual heights are not observed below a certain plasma frequency, the group refractive index is approximated by a Chebyshev polynomial expansion in the unseen region. Such an approximation simplifies the virtual height equation and enables one to invert the equation numerically. In this manner accurate true height profiles can be obtained without assuming a given functional form for the electron density distribution in the cutoff region. When a valley is present between two layers of the ionosphere, the ionogram may be reduced by treating it as a 'low frequency cutoff' problem where the critical frequency of the lowest maximum of electron density is considered to be the 'cutoff' frequency. Author (TAB)

N66-12395# Air Force Cambridge Research Labs., Bedford, Mass. Meteorology Lab.
PROJECT SAND STORM—AN EXPERIMENTAL PROGRAM IN ATMOSPHERIC DIFFUSION
John H. Taylor, ed. Sep. 1965 186 p refs *Its* Environmental Res. Papers No. 134
(ERP-134; AFCRL-65-649; AD-621658)

A series of field experiments in atmospheric diffusion was conducted at Edwards Air Force Base, California, in 1963. The primary feature which distinguished this series from similar experimental investigations was that instantaneous sources were studied. Puffs of tracer material were generated quasi-instantaneously by short bursts of small, horizontally fired, solid propellant rocket motors. Tracer samples were collected on a horizontal grid that had 350 sampling positions. All of the 43 experiments were conducted under thermally unstable atmospheric conditions. Analyses of the data identified the region of the turbulent energy spectrum which contains the eddies that are effective in diffusing the clouds. Eulerian measurements of turbulence are shown to be correlated with lateral rates of cloud growth. Downwind distributions of peak inhalation-level dosages were found to be quite irregular, with the anomalies unpredictable on the basis of measurable meteorological parameters. It was, nevertheless, possible to develop an operationally useful estimating equation relating peak dosages to distance from the source. Author (TAB)

N66-12420* Illinois Univ., Urbana. Aeronomy Lab.
IQSY ROCKET STUDIES OF THE C, D, AND E REGIONS OF THE IONOSPHERE
S. A. Bowhill *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 7 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The development of an integrated program in which a basic set of well-tried experiments would be combined on a rocket payload is reviewed. Designed for repeated use under a wide variety of ionospheric conditions, the experiments carried in the payload are described, along with the characteristics measured and the physical parameters. The payload was used in several geophysical investigations, with the following results: (1) A series of sunrise firings in July demonstrated that the presunrise C-layer (at about 60 km) is produced by photodetachment of negative ions; not by visible light, but by

light shadowed by the ozonospher (less than 3000 Å wavelength). (2) A sunrise firing in November confirmed that this effect occurs at the same solar zenith angle independent of season. (3) November sunset firings showed that the C-layer disappears within a few minutes of the same solar zenith angle at which it appears at sunrise. (4) These findings further confirmed that the D-region ionization between a height of 70 and 90 km does not appear until solar Lyman-alpha radiation has penetrated to this region. M.G.J.

N66-12474# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
EXPERIMENTAL OBSERVATIONS OF PROTON WHISTLERS FROM THE INJUN 3 VLF DATA
Stanley D. Shawhan Aug. 1965 55 p refs
(Contracts Nonr-93803; Nonr-1509(06))
(Rept.-65-29; AD-469677)

A new VLF phenomenon named a proton whistler has been identified in the VLF data from Alouette 1 and Injun 3 satellites. Two independent analyses on 12% of the proton whistler Injun 3 data were conducted: a semi-monthly sample of data for Injun 3's ten month lifetime to determine the gross features of proton whistlers; and a local nighttime and local daytime study of proton whistlers. Six assertions are made from these experimental observations. Author (TAB)

N66-12524# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
SNOW, ICE AND PERMAFROST, VOLUME XIX Bibliography With Abstracts
Frank M. Marson et al Jun. 1965 294 p refs
(CRREL-12; AD-621041)

The Bibliography provides a current and comprehensive coverage of basic and applied scientific research on snow, ice, and permafrost, as well as living and working in polar regions and other cold areas. Each entry includes a bibliographic citation, code designating the library holding of the abstracted item, assigned call number, Universal Decimal Classification number, and the abstract. This volume has a geographic index which was included as a forerunner to future editions contingent on the value derived. TAB

N66-12546# Woods Hole Oceanographic Institution, Mass.
NOTE ON THE EFFECT OF NON-LINEAR ACCELERATIONS IN THE OCEANIC EKMAN LAYER
Pierre Welander Sep. 1965 9 p refs
(Contract Nonr-2196(00))
(Rept.-65-49; AD-621369)

It is shown theoretically that the concept of an Ekman layer in the wind-driven oceanic circulation is no longer valid when the layer gets thin, and non-linear acceleration terms must be considered. The corrections may be noticeable in local regions of the ocean with strong wind gradient. Author

N66-12583# Illinois Univ., Urbana. Aeronomy Lab.
AN INVESTIGATION OF IONOSPHERE-PROTONOSPHERE COUPLING
John E. Geisler and S. A. Bowhill 1 Jan. 1965 264 p refs
(Grant NSF-GP-866)
(Rept.-5)

The solution of a form of the steady-state continuity equation for ionized hydrogen is used in conjunction with a steady-state model of the ionospheric F2-layer to show that transfer of ionization between the F2-layer and the protonosphere at a rate sufficient to affect the structure of the mid-latitude daytime layer cannot be maintained by a diffusion process. This theory is combined with the observed diurnal variation of the electron density at the F2-layer maximum to formulate a steady-state model describing the diurnal exchange of ionization between the ionosphere and the protonosphere. The rate at which ionization diffuses downward into the ionosphere at night is shown to be dependent upon the daytime ion temperature in the topside ionosphere. An expression is derived for the rate of heat input in the topside ionosphere which includes the contribution from photoelectrons which originate at and below the F2-layer maximum. Author

N66-12593# Travelers Research Center, Inc., Hartford, Conn.
THE INFLUENCE OF LOCAL WINDS ON FALLOUT Semi-annual Progress Report No. 1, 15 Oct. 1964–15 Apr. 1965
James D. Kangos and Joseph P. Gerrity, Jr. Fort Monmouth, N. J., Army Electron. Command, Aug. 1965 64 p refs *Its* Rept.-7464-164
(Contract DA-28-043-AMC-00392(E))
(ECOM-TR-00392-1; AD-620003)

Information on the structure of the sea breeze obtained by previous observational and theoretical studies has been employed for formulate a kinematic model of the wind field associated with the sea breeze. Existing information on the structure of the stabilized fallout cloud has been compiled for use in the numerical computation of the deposition of the cloud particles through specified local wind fields. A program was constructed for the numerical computation of fallout transport through an analytically presecribed two-dimensional local wind circulation and for the computation of its ground deposition pattern. The computer program was used to evaluate the fallout deposition pattern from simple models of the stabilized cloud through alternative models of the sea-breeze wind fields. The planned development of a three-dimensional kinematic model of the sea-breeze wind field and of a computer program for the computation of fallout transport through it, is discussed. Author (TAB)

N66-12625# RAND Corp., Santa Monica, Calif.
DETERMINATION OF THE D-LAYER AIR CHEMISTRY FROM A DAYTIME, HIGH-ALTITUDE NUCLEAR EXPLOSION
R. E. Lelevier Sep. 1965 12 p refs Submitted for Publication
(P-3186; AD-620952)

Measurements of the magnitude and time dependence of X-ray induced absorption over Midway during the July 9, 1962, high-altitude nuclear explosion allowed us to infer bounds on the dissociative recombination coefficient alpha of the D-layer of the ionosphere. It is shown here that a daytime experiment would allow a unique determination of alpha. By combining the daytime data with the already available nighttime data, one could infer the in situ detachment rate of the daytime ionosphere. We find that a low-yield explosion (a few KT) is adequate for the purpose of the experiment. Author (TAB)

N66-12642# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.
ON THE THEORY OF THERMODYNAMIC INTERACTION BETWEEN SEA AND ATMOSPHERE
B. A. Kagan and Z. M. Utina Mar. 1965 12 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 3, no. 2, 1963 p 250–259
(T-417-R; AD-620001)

Equations are given for obtaining the distribution of wind, temperature and humidity in the boundary layer of the atmosphere; turbulent fluxes of heat; evaporation; profiles of current, temperature, and salinity in the active layer of the sea; and turbulence coefficients in the sea and in the atmosphere. These derived quantitites, presented in terms of known parameters of the free atmosphere, and of temperature and salinity at a sufficiently great depth, enable quantitative evaluation of the effect of individual factors on the bottom layer of the atmosphere and the topmost layer of the sea. Computations were carried out by the method of successive approximations; horizontal temperature gradients in the atmosphere were not considered. Three examples are included to illustrate how the structure of the atmospheric boundary layer and the active sea layer depend on the extrinsic parameters of the problem. Analyses of the computed examples show the influence of (1) variations in velocity and direction of the geostrophic wind; (2) a decresse in the geostrophic wind; and (3) the influx of short-wave radiation. M.G.J.

N66-12645 Library of Congress, Washington, D. C. Aerospace Technology Div.

ANALYSIS OF ATMOSPHERICS PROPAGATED OVER LAND AND SEA MASSES

Stuart G. Hibben *In its* Foreign Sci. Bull., Vol. 1, No. 11 Nov. 1965 p 1–11 refs (See N66-12644 03-34)

Several studies have recently been reported in the USSR on determining spectral and other propagation characteristics of very long wave atmospherics. Data from signals obtained at ranges of less than 100 to over 6000 km are analyzed and compared to atmospherics recorded in the Pacific Ocean. Waveform behavior as a function of season, time of day, and coordinate bearing is also treated. Author

N66-12661# Defense Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.

CONCERNING SOME FEATURES OF THE CURVES OF OCCURRENCE-FREQUENCY OF pc's AT OBSERVATORIES IN THE EQUATORIAL ZONE

Antonio Romañá Jul. 1965 13 p refs Transl. into ENGLISH from Geomagnetica, Natl. Meteorol. Serv. (Lisbon), 1962 p 217–227
(T-2-Sp)

A diurnal variation curve of the occurrence-frequency of hours with pc's in the recordings of earth currents in Ghana is presented, and compared with other data on occurrence-frequency curves at equatorial observatories. In the equatorial regions the curves of frequency of hours with pc's in the earth-current records, exhibit a diurnal variation different from that which they generally have at higher latitudes. It was noted that in the Tamanrasset magnetic records, during the summer solstice months, there is a clear predominance of nocturnal pc's, with the minimum occurring in the early afternoon. It was suggested that observatories in the equatorial zone record magnetic and earth-current pc's with equipment and procedures as uniform as possible. R.W.H.

N66-12759# Joint Publications Research Service, Washington, D. C.

GEOPHYSICAL STUDIES ON THE EARTH'S CRUST

12 Nov. 1965 82 p refs Transl. into ENGLISH from Geofiz. Issled. Stroyeniya Zemnoy Kory (Kiev), no. 8(10), 1964 (JPRS-32826; TT-65-33404) CFSTI: $3.00

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5. THEORETICAL CURVES OF GRAVITY ANOMALIES OVER DOMED STRUCTURES Ye. G. Bulakh and G. L. Yevsikova p 49–55 refs (See N66-12761 03-13)

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N66-12760 Joint Publications Research Service, Washington, D. C.

THE NATURE OF THE NOVOTSARITSYNO GRAVITY ANOMALY IN THE LOWLAND CRIMEA, AS ESTIMATED ON THE BASIS OF SEISMIC STUDIES

V. B. Sollogub, A. V. Chekunov, N. I. Pavlenkova and L. A. Khilinskiy *In its* Geophys. Studies on the Earth's Crust 12 Nov. 1965 p 1–15 refs (See N66-12759 03-13) CFSTI: $3.00

A gravitational anomaly in the eastern portion of the Crimean lowland has been attributed to various occurrences and structures. A seismic study employing reflected wave techniques indicates no positive structural forms within the local sedimentary rock in the lowest beds of the Paleogene or in the strata covering it. Other explanations offered for the anomaly include the presence of heavy rocks of magmatic origin, an uplift in the sedimentary series, and a fracture in the Paleozoic foundation. Since there was such diversity of opinion regarding the anomaly, studies were made in 1962 using correlation-refraction and deep seismic sounding methods. Based on kinematic and dynamic characteristics as well as on confinement to various layers of the earth's crust, waves were classified as from (1) seismic horizons in sedimentary rocks, (2) surface of foundation and nearby interfaces, and (3) horizons within the crystalline portion of the earth's crust. The dense rocks which fill an abyssal fracture near the central portion of the Novotsaritsyno ledge are considered the primary cause of the anomaly; the ledge itself is considered to have a secondary influence. M.W.R.

N66-12761 Joint Publications Research Service, Washington, D. C.

THEORETICAL CURVES OF GRAVITY ANOMALIES OVER DOMED STRUCTURES

Ye. G. Bulakh and L. G. Yevsikova *In its* Geophys. Studies on the Earth's Crust 12 Nov. 1965 p 49–55 refs (See N66-12759 03-13) CFSTI: $3.00

Computation and construction of theoretical curves are given for gravitational anomalies over domed structures which are bounded vertically. An electronic computer was used for the

calculations which were computed, partly, from profiles passing through the epicenter of the hyperboloid. In the case of anomalies over several domes, it was necessary to construct curves which did not pass through the epicenter. The resultant atlas of curves permits rapid construction of the gravity field over a complex geological object which has a domed structure.
M.W.R

N66-12765# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COLLECTION OF ARTICLES ON THE INTERNATIONAL GEOPHYSICAL YEAR, ISSUE 2
18 Aug. 1965 132 p refs Transl. into ENGLISH from Sb. Rabot po Mezhounarodnomu Geofiz Godu (Kiev), Issue 2, 1963 (FTD-TT-65-335/1+2; AD-620504)

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10. SIMILARITIES BETWEEN THE AURORAE BOREALIS AND AUSTRALIS G. A. Rubo p 140–150 refs (See N66-12775 03-29)

N66-12766 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOGRAPHIC OBSERVATIONS OF METEORS IN 1958 AT THE KIEV ASTRONOMICAL LABORATORY
V. V. Benyukh, S. P. Vil'chinskaya, A. A. Demenko, Yu. N. Krivutsa, Ye. V. Sandakova et al *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 1–10 refs (See N66-12765 03-13)

Results are given for photographic observations of meteors made from two base line stations at the Kiev Astronomical Laboratory. Coordinates of the meteor points were determined by the Deutsch method; and star magnitude of these points was found by comparison with the brightness of either an artificial meteor or star trails. Corrections were introduced to account for atmospheric absorption, and stellar brightness was computed from equatorial values. Data are given for angular length, drag factors, preatmospheric velocity, maximum absolute stellar magnitude, altitude of appearance and disappearance, and angle of conversion between celestial meridians of the meteors. Each meteor is also observed at several points along its course.
M.W.R.

N66-12768 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SCATTERING OF RADIOWAVES FROM UNDERDENSE METEOR TRAINS
I. V. Bayrachenko *In its* Collection of Articles on the IGY Issue 2 18 Aug. 1965 p 46–54 refs (See N66-12765 03-13)

Magnitude of signal power during radio wave scattering from underdense meteors is treated for the case when polarization of incident electromagnetic wave varies with respect to train axis. When the influence exerted by the distribution of electrons in the column is considered, the resultant coefficient of reflection is a function of both distribution of electron density in the column as well as of spatial orientation within the meteor train. It is found that observed values of polarization ratios are consistently higher than theoretical estimations of resonance effects, which indicates the need to study further resonance effect brought about by the transverse components of the electrical field of the incident wave. Equations are evolved for determining the power of the received signal reflection coefficient ratio.
M.W.R.

N66-12769 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF THE ANTENNA DIRECTIVITY PATTERN ON THE OBSERVED DISTRIBUTION OF METEOROIDS WITH RESPECT TO MASS
R. I. Moysya, V. G. Kruchinenko, and I. V. Bayrachenko *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 55–77 refs (See N66-12765 03-13)

An evaluation is made of the influence of antenna directivity pattern in the vertical plane based on meteor radio observations. Problems related to the theory of radio wave scattering from meteor trains include selection of electron density and mass interval. Distribution and duration of radio meteors is found for a transitional region for which $\alpha \sim 10^{12}$ el/cm, a region in which the determination of polarization ratios for short duration echoes does not explain observed phenomena. Since plasma resonance does take place in this region, it is possible to use theoretical results obtained for the region of unstable trains; and methods for evaluation of data are discussed. Results are compared for an undirected, slightly directed, and acutely directed antenna; and a study of derived data concludes that a break in the logarithmic curve in the region of small and intermediate durations may be due to antenna directivity influences. The shape of the duration distribution function for observed meteors of intermediate and large durations approaches that of the actual meteoroid distribution function mass.
M.W.R.

N66-12830# Woods Hole Oceanographic Institution, Mass.
AN EFFECT OF SOLID ROTATION ON DIFFUSION PROCESSES, WITH POSSIBLE APPLICATION TO LARGE-SCALE TURBULENT TRANSPORTS IN THE ATMOSPHERE AND THE OCEAN

Pierre Welander Jun. 1965 14 p refs
(Contract Nonr-2196(00))
(Rept.-65-25; AD-621387)

A gas in solid rotation that is subjected to a radial temperature gradient develops a component of heat diffusion at right angles to the gradient. The magnitude of this diffusive flux, relative to the radial component, is $\frac{2\lambda\Omega}{\nu}$ where λ and ν are the mean free path and the mean radial speed of the molecules, respectively, and Ω is the angular velocity of the system. Corresponding effects occur in diffusion of mass and momentum. It is suggested that the same effect becomes important in the large-scale turbulent transports in the atmosphere and the oceans. The prediction is that a general eastward eddy heat flux should occur. The eastward eddy heat fluxes in the Gulf Stream going up the gradient of temperature can be explained by this mechanism. More observations of the diffusive fluxes in the atmosphere and the oceans are, however, required to test the theory. Author (TAB)

N66-12835# Intermountain Weather, Inc., Salt Lake City, Utah.
THE INFLUENCE OF HAZE UPON LONG WAVE RADIATION Interim Report, 1 Dec. 1964–31 May 1965
Wilford Zdunkowski, Donald Henderson, and J. Vern Hales Jul. 1965 47 p refs
(Contract DA-28-043-AMC-00122(E))
(IR-2; AD-621650)

Temperature changes due to the combined effects of radiation and turbulence were computed using the ideas of Interim Report No. 1 ('The Effect of Atmospheric Haze on Infrared Radiative Cooling Rates', W. Zdunkowski, D. Henderson, and J. Vern Hales.) It was found that the results correspond with the general idea that radiation effects should not be neglected. The numerical results are not yet satisfactory and further experimentation is necessary. An error was discovered in Interim Report No. 1 for the computations including reflected radiation. The revision is included as an appendix to this report. Author (TAB)

N66-12879# RAND Corp., Santa Monica, Calif.
A CHEBYSHEV APPROXIMATION TO THE EARTH'S EXTERNAL GRAVIPOTENTIAL WITH INTERNALLY UNRESTRICTED MASS DISTRIBUTION
M. L. Juncosa and R. K. C. Johns Sep. 1965 33 p refs
(Contract AF 49(638)-700; Proj. Rand)
(RM-4677-PR; AD-621044)

The global external gravitational potential is developed in a series of polynomials of direction cosines and inverse powers of the radius closely related to an expansion of the potential in spherical harmonics. The Chebyshev fitting criterion is used to obtain the coefficients in several sets of approximations. To various (up to nearly six) numbers of significant figures, these approximations agree with comparable customary expansions in zonal and tesseral harmonics whose coefficients are usually obtained with the less stringent least-squares criterion, but they contain fewer coefficients. Chebyshev linear fitting problems are equivalent to linear programming problems for which many routines already exist for use on electronic digital computers. The use of fewer coefficients and simpler functions in the expansion yields computational advantages. Because the internal mass distributions producing identical external potentials are not necessarily unique, no assumptions on the internal mass structure are made. Author (TAB)

N66-12895# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
WINTER 1965 FIELD TESTS OF UREA, ION INCORPORATED SILICA AND HYDROPHOBED SILICA AS SEEDING REAGENTS
John B. Kidney 1 Oct. 1965 37 p refs
(Grant NSF-G-22419)
(TN-31)

During the winter of 1965, a series of airborne cloud seeding experiments was undertaken to field test the effectiveness of three new seeding agents: hydrophobed silica, ion incorporated silica and milled urea. These materials were used in cold winter stratus clouds with varying degrees of success as described herein. All of the materials tested produced showers that could definitely be ascribed to seeding, with urea producing a shower on one occasion equal to or better than the best dry ice shower. The results of the experiments indicate that a certain minimum crystal concentration is necessary to trigger a cloud into precipitation. Author

N66-12896# National Academy of Sciences—National Research Council, Washington, D. C. World Data Center A.
GRAVITY, TSUNAMIS SEISMOLOGY, LONGITUDE AND LATITUDE, METEOROLOGY Catalogue of Data, 1 Jul. 1957–30 Jun. 1965
Sep. 1965 41 p refs

A catalog of gravity, tsunami, seismology, and longitudinal and latitude data received by the IGY World Data Center A from July 1, 1957 through June 30, 1965 is presented. Also listed are all the post IGY/IGC meteorological data received prior to June 30, 1965. R.N.A.

N66-12941# Royal Aircraft Establishment, Farnborough (England).
METHODS OF DETERMINING AIR DENSITY FROM SATELLITE ORBITS
D. G. King-Hele Sep. 1965 32 p refs
(RAE-TR-65212) CFSTI: HC $2.00/MF $0.50

This paper reviews the methods for determining the air density at heights near a satellite's perigee by analysing the changes in its orbit. The limitations and accuracy of the method are discussed, and possible future developments are outlined. Author

N66-12946# Joint Publications Research Service, Washington, D. C.
CHARACTER OF THE TEMPERATURE CHANGE WITH DEPTH IN THE UPPER LAYERS OF THE EARTH'S CRUST
R. I. Kutas 29 Oct. 1965 8 p refs Transl. into ENGLISH from Issled. Fiz. Parametrov Veshchestva Zemnoy Kory (Kiev), v. 11, no. 9, 1964 p 114–117
(JPRS-32618; TT-65-33097) CFSTI: $1.00

The formation of the heat regime of the earth's crust is influenced by a large number of factors which can be combined into two groups: those related to the distribution of heat sources and their intensity, and those related to heat transfer conditions. In the upper layers of the earth's crust the main influence on the formation of the heat regime apparently is exerted by the second group of factors. In the case of individual geological regions in which heat transfer conditions are maintained over a considerable area, there should be definite patterns in the distribution of geothermal parameters. By analyzing actual data from geothermal observations by the methods of mathematical statistics, it is possible to derive some empirical relations of the change of temperature with depth. In order to obtain such relationships, temperature values obtained in boreholes which had rested from 20 days to several years were used. The heat regime in such boreholes can be considered steady state. R.N.A.

N66-12971# Oslo Univ., Blindern (Norway). Norwegian Inst. of Cosmic Physics.

MULTI-CHANNEL EQUIPMENT FOR RECORDING VLF-EMISSIONS IN THE FREQUENCY-RANGE 2–16 Kc/s

L. Harang, R. Larsen, and J. Skogtvedt 25 Apr. 1965 16 p refs *Its* Sci. Rept.-1

(Contract AF 61(052)-811)

(AFCRL-65-512; AD-620870)

The preliminary results of recordings of VLF-emissions at Tromsø ($\phi = 69°40'$ N, $\lambda = 18°57'$ E Gr) in the frequency range 2 to 16 kc/s are presented, using five-channel equipment with center frequencies at 14.7, 12.3, 7.2, 4.7 and 2.3 kc/s. The power spectral densities of typical burst events were measured at each of the five center frequencies. At the lowest frequency no amplitude, or very faint amplitudes appeared. In the band 4 to 7 kc/s the densities were of the order 10×10^{-16} W/m^{2}c. On 15 kc/s the density had increased to 60–70 $\times$ 10^{-16} W/m^{2}c, there is thus an increase of 3 to 5 times. The center frequency of the emissions therefore lies at a higher frequency than 15 to 20 kc/s. Author

N66-12981*# California Univ., Berkeley. Lawrence Radiation Lab.

OCCURRENCE OF BIOGENIC STERANES AND PENTACYCLINC TRITERPANES IN AN EOCENE SHALE (60 MILLION YEARS) AND IN AN EARLY PRE-CAMBRIAN SHALE (2.7 BILLION YEARS) Preliminary Report

A. L. Burlingame, Pat Haug, Theodore Belsky, and Melvin Calvin [1965] 14 p refs

(Grant NsG-101)

(NASA-CR-68305) CFSTI: HC $1.00/MF $0.50 CSCL 08G

The isolation and identification of C_{27}-, C_{28}-, and C_{29}-steranes and of a C_{30}-penta-cyclic triterpane from the branched-cyclic alkane fraction of Green River shale, is reported. Preliminary mass spectral examinations of the collected fractions established the molecular weights of their major components, and subsequent isothermal separations isolated homologous compounds with mass spectral fragmentation patterns that were characteristic for the saturated, tetracyclic sterane carbon skeleton. This presence of C_{28}- and C_{29}-steranes in various glc fractions was attributed to abiogenic reduction of their precursors, e.g., ergosterol, etc. Gas-liquid chromatographic runs of branched-cyclic alkane fractions from the Soudan shale yielded a mass spectral fragmentation pattern indicating the presence of C_{27}-, C_{28}-, and C_{29}-saturated, tetracyclic hydrocarbons. The striking predominance of the sterane and penta-cyclic triterpane constituents in the branched-cyclic alkane fraction of the non-marine Green River shale contrasted sharply with the much lower relative abundance of these compounds in the Soudan shale which is of marine origin and of much greater age. G.G.

N66-12982*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

DENSITY VARIATIONS IN THE HETEROSPHERE

Luigi G. Jacchia 20 Sep. 1965 27 p refs Presented at the I.A.G.A. Aeronomy Symp., Cambridge, Mass., 16–20 Aug. 1965

(Grant NsG 87-60)

(NASA-CR-68304; SAO Special Rept.-184) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Five separate types of density variations are recognized in the upper atmosphere at satellite heights. These are: (1) day-to-night variations, (2) variations with solar activity, (3) variations with geomagnetic activity, (4) semiannual variations, and (5) latitude-dependent seasonal variations. Each type of variation is reviewed, together with the present state of knowledge concerning its origin. Author

N66-12986*# Australian National Univ., Canberra. Dept. of Geophysics.

FRACTIONATION OF FLUORINE, CHLORINE AND OTHER TRACE ELEMENTS DURING DIFFERENTIATION OF A THOLEIITIC MAGMA

L. Greenland and J. F. Lovering [1964] 42 p refs

(Grants NsG-319-6; NsG-322) CFSTI: HC $2.00/MF $0.50 CSCL 08D

The elements F, Cl, Ni, Co, Cu, Ga, Sc, Cr, V, Ba and Sr have been determined in two drill cores through a differentiated tholeiitic dolerite sill from Tasmania. A multivariate statistical technique is employed to demonstrate the occupancy of hydroxyl lattice sites by both chlorine and fluorine. Consideration of trace-element/major element ratios suggests that, in these dolerites, Ni occupies Fe^{+2} sites, Co and Sc replace both Mg and Fe^{+2}, Cr replaces Fe^{+3}, V^{+4} replaces Ti, Ga replaces Al, and Ba and Sr both replace Ca. Author

N66-12992*# Southwest Center for Advanced Studies, Dallas, Tex.

MULTIDISCIPLINARY RESEARCH IN SPACE-RELATED SCIENCE AND TECHNOLOGY Semiannual Report

30 Sep. 1965 101 p refs

(Grant NsG-269-62)

(NASA-CR-68362) CFSTI: HC $4.00/MF $0.75 CSCL 04A

Research activities from April through September, 1965 centered on various studies of planetary atmospheres, ionospheric and radio physics, particles and fields, and planetology. This summary contains the following topics: History of earth atmopshere; atmospheric and ionospheric structure; plasmas; geomagnetic variations; energetic particles; auroral current systems; planetary atmospheres and interplanetary physics; atmospheric chemistry; infrared studies; lunar investigations; geochemistry; planetary structure; paleomagnetism; kinetic theory; spinors and cosmology; gravitational radiation; various mathematical calculations; and space technology studies. G.G.

N66-12993*# Stanford Univ., Calif. Radioscience Lab.

ECCENTRIC GEOPHYSICAL-OBSERVATORY SATELLITE S-49 WITH INTERPRETATION OF THE RADIO-BEACON EXPERIMENT Technical Report No. 1

A. V. Da Rosa Jun. 1965 63 p refs

(Contract NASr-136)

(NASA-CR-68307; SEL-65-063) CFSTI: HC $1.00/MF $0.75 CSCL 04A

The S-49 satellite, launched on 5 September 1964, carried a pair of radio beacons operating at harmonically related frequencies modulated by 20- and 200-kc signals. The radio-beacon experiment was designed to investigate the exosphere by studying the behavior of the columnar electron content between ground and satellite as the latter moves from perigee to apogee in its highly eccentric orbit. To avoid errors arising from over-simplified assumptions about the dense ionosphere, which would mask the effects in the exosphere, simultaneous measurements were made of the differential-Doppler frequency and the Faraday-rotation angle. The former provides columnar-content information from ground to transmitter while the latter yields columnar-content information determined mainly by the ionization in the lower ionosphere. The difference between the contents thus obtained can be attributed to the columnar content of the exosphere up to satellite height and should be essentially indpenendent of variations in the lower ionosphere. The objective of the present report is to describe the underlying principles and the techniques for translating the rad data received from the EGO

beacon experiment into curves of slant columnar content in the exosphere vs time. These curves are the starting point for an analysis of the exospheric behavior. Such an analysis, however, is not a part of the present report. The usual first-order analysis of the differential-Doppler-frequency and the Faraday-rotation-angle data is complicated in the present case by the rotation of the satellite antenna. The effect of this rotation is investigated and methods for taking it into account are developed. The effects of various approximations usually made in the first-order analysis are investigated and, when necessary, proper corrections are introduced. In brief, the use of this report will permit the specification of scaling techniques for the records bearing the raw data from the satellite and the writing of computer programs that will yield exospheric columnar contents. Author

N66-13086*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIFFUSION OF LOW ENERGY AURORAL ELECTRONS IN THE ATMOSPHERE
Kaichi Maeda Jun. 1964 31 p refs
(NASA-TM-X-55023; X-640-64-150) CFSTI: HC $2.00/MF $0.50 CSCL 04A

By means of the Monte Carlo method, Spencer's work on the energy dissipation of electrons in air is extended below 25 Kev, and the results are applied to the diffusion of monoenergetic electrons in the polar atmosphere. The results show significant effects of straggling, not only on the distribution of the most penetrating flux but also on the height of maximum dissipation and on the back-scattering. The dependence of back-scattering on the angular distributions as well as the energies of incident electrons are calculated, indicating that it decreases rapidly below 10 Kev and that a maximum of back-scattering seems to occur at energies around 20 Kev, with values of the order of 7% and 20% for vertical and isotropic incidence, respectively for intensity. Corresponding energy back-scattering coefficients (albedos) are approximately half of these values. Author

N66-13135# Brookhaven National Lab., Upton, N. Y.
VERTICAL STRUCTURE OF TURBULENCE
H. A. Panofsky (Pa. State Univ.), and Irving A. Singer [1964] 21 p refs
(Contract AT(30-2)-GEN-16)
(BNL-8516)

Based on fluctuation statistics from the Brookhaven tower, statistical models are presented which permit estimation of cross spectra between wind components at various heights. It is shown that a similarity hypothesis proposed by Davenport seems to be valid. The turbulent eddies slope into the wind, with slopes of order unity, probably dependent on wind shear. In free convection, eddies are taller than wide, but in mechanical turbulence and forced convection the reverse is true. Author

N66-13151*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
THE THEORY AND EXPERIMENTAL RESULTS OF AN IONOSPHERIC PROBE EXPERIMENT Scientific Report No. 260
Douglas S. Hoffman Jan. 1966 77 p refs
(Grant NsG-134-61)
(NASA-CR-68459) CFSTI: HC $3.00/MF $0.75 CSCL 04A

A multigridded probe experiment for the measurement of ionospheric parameters is described. A theoretical analysis of the operation of the probe under typical sounding rocket conditions indicates the performance to be expected in the determination of these parameters. In addition to the dc probe characteristics, the time derivative of the probe characteristics was also obtained in flight. Data from the experiment were analyzed in light of the theory. The following ionospheric parameters were obtained: an ion density profile for altitudes from 280 to 940 km, vehicle potential, and ion temperature. The analysis showed that the probe ceased to function according to simple ram theory at the altitude where the ion sheath thickness was equal to the diameter of the probe assembly. Some difficulties associated with ion probe measurements are pointed out, and practical suggestions for designing better ion probes are made. Author

N66-13152*# Smithsonian Institution, Washington, D. C.
A CHONDRULE IN THE CHAINPUR METEORITE
Kurt Fredriksson and Arch M. Reid (Scripps Inst. of Oceanog.) [1964] 9 p refs
(Grants NsG-317-63; NsG-688)
(NASA-CR-68408) CFSTI: HC $1.00/MF $0.50 CSCL 08G

The occurrence of glass as a major constituent in a chondrule from the Chainpur meteorite provides further evidence that the chondrules formed by rapid cooling of liquid droplets. The distribution of nickel and iron between metal and silicates shows that iron was present when the chondrules solidified, and that the metal formed by reduction in the molten stage, thus extracting virtually all nickel. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-12170*# Lockheed Aircraft Corp., Burbank, Calif.
SOME ASPECTS OF HYPERALTITUDE PHOTOGRAMMETRY Report No. 1
R. M. L. Baker, Jr. Jan. 1964 118 p refs
(Contract NAS5-3390)
(NASA-CR-68275; LR-17491) CFSTI: HC $4.00/MF $0.75 CSCL 08E

Certain problems pertinent to the interpretation of hyperaltitude photographs are discussed. Problems such as determining camera position in latitude, longitude, and altitude at the time of exposure; camera direction; location of points of interest in a photograph; and the effects of relief displacement and atmospheric refraction on the position of images are treated. R.N.A.

N66-12171*# Lockheed Aircraft Corp., Burbank, Calif.
PHOTO INTERPRETATION OF WHITE SANDS ROCKET PHOTOGRAPHY Report No. 2
Paul M. Merifield and James Rammelkamp Mar. 1964 92 p refs
(Contract NAS5-3390)
(NASA-CR-68274; LR-17666) CFSTI: HC $3.00/MF $0.75 CSCL 08B

This study was conducted to help define the role of hyperaltitude photography in determining the physical characteristics of planetary surfaces. Photographs taken at altitudes

between 70 and 200 km are analyzed to determine what physical features can be identified, and what problems in interpretation are peculiar to photography from great altitudes. Attention is focused on such natural features as drainage patterns, geomorphic landforms, surface composition, relief and texture, and geologic structure. In addition to the purely descriptive aspects of the photos, special interest is given to information which was previously unknown or difficult to obtain by other means. The photographs cover a large portion of the southwestern United States and Sonora, Mexico, and were taken by the V-2 No. 40, Viking 11 and 12, and Aerobee rockets. The region is well suited to photogeologic interpretation because of the diversity of the geology, the prominant outcrops, and the lack of vegetation. R.N.A.

N66-12175*# Chicago Univ., Ill. Dept. of Biophysics.
ELECTRON MICROSCOPY WITH SUPERCONDUCTING LENSES
H. Fernández-Morán [1965] 10 p refs
(Grants NsG-441-63; NIH NB-04267; NIH GM-13243; Contract AT(30-1)-1344)
(NASA-CR-68278) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Experiments were successfully performed with a specially designed electron microscope using high field superconducting niobium–zirconium solenoid lenses in an open air core liquid helium Dewar. The experiments demonstrated the stability of the images recorded over periods of continuous operation of 4 to 8 hours, and the high quality of the images. Other experiments, using different types of electron microscopes with superconducting solenoid lenses, also confirmed the exceptional stability of the images and their unimpaired high quality over extended periods. The preliminary results of experiments using superconducting lenses in combination with pointed filament sources, and new observations on imaging phenomena with superconducting solenoid lenses are providing essential data for the design of new types of miniaturized cryo-electron microscopes immersed in a liquid helium cryostat, and of a separate superconducting solenoid objective lens with appropriate pole pieces and stigmators for use with modern high resolution electron microscopes. Advantages and other applications of superconducting lenses are discussed. R.N.A.

N66-12191*# Wyle Labs., Inc., Huntsville, Ala. Testing Div.
THE EFFECTS UPON SHOCK MEASUREMENTS OF LIMITED FREQUENCY RESPONSE INSTRUMENTATION
M. J. Crocker and L. C. Sutherland Jan. 1965 35 p refs
(Contract NAS8-11217)
(NASA-CR-68216; WR-65-1) CFSTI: HC $2.00/MF $0.50 CSCL 14B

In this report, the modifications to an ideal shock pulse provided by various measuring systems with different frequency response limitations are determined analytically. The measuring systems considered are one with low frequency attenuation, one with high frequency attenuation and a system with both high and low frequency attenuation. The approach which is adopted is to obtain the Fourier transform of an ideal shock pulse and by the use of the System Frequency Response Function to obtain the measured time history of the shock pulse. The measured time histories for each system are computed for various sytem cut-off frequencies. The computations indicate the effects upon the measured shock peak and length of its positive phase due to limitations in frequency response of the measuring systems. Author

N66-12197*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PLANETARY PHOTOGRAPHY: TELEVISION CAMERA FOR A GEOLOGICAL SURVEY OF THE PLANET MARS
L. R. Malling 20 Jul. 1962 13 p refs
(Contract NAS7-100)
(NASA-CR-68127; JPL-TM-33-76) CFSTI: HC $1.00/MF $0.50 CSCL 14E

High-resolution pictures of the planets may be obtained with an electronic camera mounted on a spacecraft. Special techniques must be used to process the pictures to allow transmission back to Earth at planetary distances. An electrostatic Vidicon is shown to be a particularly useful transducer for planetary photography. An experimental flight camera system is described with some of the results obtained in the laboratory. Author

N66-12231* National Aeronautics and Space Administration, Washington, D. C.
THERMOELECTRIC METHODS OF MEASURING TEMPERATURE INCORPORATING A MEMORY DEVICE
V. Pak *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 205–213 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Automatic devices for measuring small temperature drops and average temperature can be used to investigate nonstationary thermal processes which occur in electrically conducting objects. Since there is no electrical insulation between junction and object, methodological errors in measuring temperature are substantially reduced. Measurement of temperature drop by (1) two thermocouples, with thermoelectrodes connected to a bridge circuit and (2) two differential thermocouples is considered; and temperature drops in the dynamic state are discussed. The thermoelectric method for measuring average temperature of an electrically conducting medium is also covered. Proposed methods of measuring the difference in the thermoelectromotive force and the average value of sensor readings may be of use in other areas of electrical measurement of nonelectric quantities, such as tensometry. M.W.R.

N66-12232* National Aeronautics and Space Administration, Washington, D. C.
METHOD OF MEASURING TEMPERATURE UNDER CONDITIONS OF HIGH NOISE LEVEL
A. N. Ser'yeznov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 214–222 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

A three-electrode thermocouple with a transformer which compensates for noise is found to be feasible for measuring temperatures at high interference levels when conventional methods for decreasing level of interference do not produce desirable results. This thermocouple is particularly useful in cases where there is a sharp variation in temperature. Compensation takes place because the interference emf induced in one of the loops of the transformer is applied to the primary winding W_1 and produces an emf of opposite sign in the primary winding W_2. With proper selection of corresponding inductances of these windings, almost complete compensation can be achieved. Equations are evolved for the circuit, amplitude-phase characteristic of the thermocouple-filter system, and the difference between the steady state and transient values. M.W.R.

N66-12233* National Aeronautics and Space Administration, Washington, D. C.

PYROMETER FOR CONTACTLESS MEASUREMENT OF TEMPERATURE ON THE SURFACE OF A TRACTION MOTOR ROTOR WHEN AN ELECTRIC LOCOMOTIVE IS MOVING

P. G. Nikitin and Yu. N. Sitnikov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 223–229 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

A pyrometric device for remote and contactless measurement of traction motor rotor surface temperatures of moving locomotives is described. Technical specifications for the device are given, and a schematic diagram of the sensor is shown. The calibration procedure for the device is described, and a curve is given showing the variation in thermoelectromotive force of the heat-sensitive sensor as a function of the surface temperature of heated bodies. Further improvement must be made on the pyrometer to work well under actual electric locomotive operating conditions, but the results thus far are very promising. L.S.

N66-12235* National Aeronautics and Space Administration, Washington, D. C.

PHOTOELECTRIC MANOMETER FOR REMOTE CONTROL

M. B. Mayzel *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 236–246 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

A photoelectric manometer for remote control in a servosystem is described. Diagrams are included, and the advantages and disadvantages are cited. The metrological and technical characteristics are given along with a brief theoretical treatment. It was found that an experimental version with readings telemetered to a digital indicator operates in a stable manner under laboratory and operational conditions. An error analysis was conducted, and improvement areas are suggested. C.T.C.

N66-12236* National Aeronautics and Space Administration, Washington, D. C.

ON THE DYNAMIC CHARACTERISTICS OF POTENTIOMETRIC PRESSURE SENSORS

K. T. Ilingin and A. M. Smirnov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 247–253 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

The development of dynamic characteristics of potentiometric pressure sensors and a hydraulic test stand are given. The investigation shows that it is possible to use these sensors to measure pressure oscillations in hydraulic systems. Also, the special features associated with the operation of these sensors under dynamic conditions are shown. The hydraulic test stand makes it possible to determine the dynamic characteristics by the frequency method. C.T.C.

N66-12237* National Aeronautics and Space Administration, Washington, D. C.

A DEVICE FOR MEASURING THE SIGNALS FROM STRAIN GAGES AND THEIR RATE OF GROWTH

A. A. Bessonov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 254–258 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

The operation of and applications of a device consisting of a strain gauge bridge sensor and an amplifier designed for automatic continuous and remote measurement of signals generated by strain gauges (and of their variation rates) are described. The device instantaneously records the limiting value of these signals, and can be used for all forms of measurements carried out by means of strain gauges. The device was experimentally verified by measuring pressures in 3 ranges (up to 12 atm) and their rates of variation up to 10^3 atm/sec, and results indicate that the total error does not exceed 2% of full scale deflection on each range. The sensitivity of the measurement channel for each of the ranges is 6 V/atm. The device was also statically calibrated by means of a special hydraulic press. The dynamic error was evaluated by comparing the experimental curves for pressure variation recorded by the device with the curve of a typical process. A photograph of the device, and a circuit diagram of the amplifier-converter are given. L.S.

N66-12238* National Aeronautics and Space Administration, Washington, D. C.

CONDUCTOMETRIC FREQUENCY SENSORS USING RC-GENERATORS

L. A. Granitskaya and B. A. Lopatin *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 259–266 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Methods of building frequency sensors using various types of RC-generators with ladder-type, Γ-type, or P-type networks are described. The frequency of the various combinations were measured as a functon of electrical conductivity or concentration in the cell units; and the sensitivity of the cells with different netowrk combinations were compared. Diagrams showing different versions of cells with the ladder-type, Γ-type, and P-type networks (e.g. a network with 4 capacitors in parallel, a network with 4 resistors in parallel, and other combinations) are presented. The sensitivity data will be used for developing theoretical principles for methods of conductometry utilizing frequency modulation in RC-generators. L.S.

N66-12239* National Aeronautics and Space Administration, Washington, D. C.

A PARAMETRIC SERIES OF GRAIN HYGROMETERS

N. A. Gordeyev *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 267–273 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Parameters of hygrometers used to determine moisture content in grains were studied for the purpose of designing specialized hygrometers useful at various parts of the grain flow process. The requirements of the various hygrometers vary as to size, weight, portability, accuracy, and other factors. The operations of the grain transportation process are described with respect to harvesting, receiving, storing, drying, conditioning, and delivering. A series of recommendations are made for a series of grain hygrometers to be used in the various steps of the processing, listing the specifications for each hygrometer. L.S.

N66-12240* National Aeronautics and Space Administration, Washington, D. C.

SOME APPROACHES TO THE DEVELOPMENT OF INFRASONIC VIBROMETERS

B. E. Arshanskiy *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 274–280 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

The use of a small disbalance mass in the design of infrasonic (below 1 cps) vibrometers for measuring infrasonic oscillations of transport objects is discussed. Other ideas discussed with reference to improving the measurement of vibration amplitude, and for expanding the operating range of

vibrometer devices, are variation of the transfer coefficients of the instrument circuits; introduction of controlled feedback; and adjustment of electrical and mechanical components. L.S.

N66-12241* National Aeronautics and Space Administration, Washington, D. C.
DEVICES FOR MEASURING THE TIME CHARACTERISTICS OF RELAYS
A. I. Larkin, Ye. I. Razuvayev, and D. K. Vinogradov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 281–286 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

The engineering characteristics, principles of operation, and circuit diagrams are presented for electromagnetic relay devices used to switch electric circuits, control mechanisms, send signals, etc. In the proposed devices, the time characteristics of the relays are measured by the make and break times of electromagnetic dc relays, both when a constant voltage is applied, or when a series of square pulses with various parameters are applied to the relay winding. L.S.

N66-12285# Ball Bros. Research Corp., Boulder, Colo.
DESIGN AND DEVELOPMENT OF THE BALLOON-BORNE SOLAR POINTER BBSP-200 Final Report, 15 Jul. 1964–3 May 1965
Marvin E. Greeb 20 Apr. 1964 136 p
(Contract AF 19(628)-4314)
(F65-7; AFCRL-65-604; AD-621704)

The report summarizes the results of the design, development, and test program of the balloon-borne biaxial solar pointing control, Series BBSP-200. The objective of this program was to develop a system capable of orienting a research instrumentation package toward the center of the solar disc while it is suspended from a high-altitude balloon for an unattended flight period of not less than 10 hours with an accuracy of better than ±5 minutes of angular arc in both axes. Author (TAB)

N66-12348*# Lockheed Nuclear Products, Marietta, Ga.
MODIFICATION AND MAJOR OVERHAUL OF CRYOGENIC IRRADIATION FACILITY AT PLUMBROOK REACTOR FACILITY
[1964] 165 p
(Contract NAS3-6210)
(NASA-CR-54770; ER-8207) CFSTI: HC $5.00/MF $1.00 CSCL 14B

Implementation is discussed for the overhaul, modification, repair, and instrument calibration of the equipment used in combined nuclear-cryogenic material studies. The equipment includes a gaseous phase helium refrigerator system, the test loops with their transfer system, and associated instrumentation and appurtenances. The report includes a reliability evaluation of the equipment and a projected maintenance schedule predicated on the results. Author

N66-12373# CTS Corp., Elkhart, Ind. Research and Development Div.
PRODUCTION ENGINEERING MEASURE FOR SUBMINIATURE, TRANSISTOR TYPE POTENTIOMETERS Quarterly Progress Report, 1 Jan.–31 Mar. 1965
C. L. Holmes and D. C. Kinsey [1965] 22 p
(Contract DA-36-039-SC-85976)
(QPR-15; AD-621355)

Eighteen hundred samples were fabricated and tested to SCS-112 Technical Requirement which did not satisfactorily perform all the requirements. Sixteen hundred controls were refabricated and retested in an attempt to meet those test requirements which were not met on the first 1800 group. After completion of the second test group, test specifications of Technical Requirement SCS-112 had been met satisfactorily on all tests except moisture resistance on the 50 Omega controls of both styles and rotational life testing on the 25000 Omega bushing mount style. Because these two specification requirements are beyond the present state of the art. Technical Action Request No. 8 was submitted to request a change in test requirements. The 2400 controls on the 10000 hour load life high reliability study have completed the testing phase with very satisfactory results. A summary of this test data is included. Author (TAB)

N66-12447# Aeronautical Research Council (Gt. Brit.)
A DIGITAL RECORDING SYSTEM FOR STRUCTURAL RESEARCH
D. Purslow London, HMSO, 1965 80 p Supersedes RAE-TN-STRUCT -365; ARC-26596
(ARC-CP-825; ARC-26596; RAE-TN-STRUCT.-365) HMSO: 18s

The recording system described measures the output of strain gauge bridges, displacements by determining the position of potentiometer wipers, temperature by use of chromel-alumel thermocouples, and the millivolt output of any D.C. transducer. The measurements are recorded on punched cards and in typescript. The methods used to measure the different types of transducer signal are surveyed and detailed operating procedures are given. Author

N66-12506# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FITTING FOR A THERMOANEMOMETER
V. A. Novikov and V. M. Filippov 28 Jun. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 157566 (Appl. no. 810867/26-10, 29 Dec. 1962) 2 p
(FTD-TT-65-204/1+2+4; AD-620093)

Object of the invention: The fitting of a thermoanemometer for measuring the transverse components of pulsation speed of an air flow designed in the form of a two-filament wire receiver, the distinguishing feature of which is that for the purpose of measuring the transverse components of the speed in mutually perpendicular planes with one and the same receiver in it, the heat of the holder is designed so as to swivel. Author (TAB)

N66-12551# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROTATIONAL ELASTOVISCOSIMETERS FOR STUDYING POLYMERIC SYSTEMS
G. V. Vinogradov, I. M. Belkin et al 28 May 1965 12 p refs Transl. into ENGLISH from Zavodsk. Lab. (Moscow), v. 30, no. 3, 1964 p 364–367
(FTD-TT-65-144/1+2; AD-620969)

Rotational viscosimeters of the cone-plane type are described wherein the material under investigation is placed in a gap between the working surfaces, i.e., a rotating plane and a stationary cone. Elastoviscosimeters of the cone-plane type are intended for such rheological investigations as the measurement of viscous and elastic properties of polymeric systems. The rotational viscometer REV-1 is described that is intended for studying highly viscous media, in the range from −30 to 300° C, in air, in vacuum (to about 0.001 mm Hg) and in an inert gas. The material being investigated is loaded

into the device in the form of cone-shaped tablets (about 5g); the error in measuring torque does not exceed 1% and in measuring viscosity, 4.5%. The REV-1 may be modified to measure elasticity wherein the origination of stress is normal to the plane of displacement; the modification uses 2 conical surfaces and permits lower rates of deformation than the coneplane system. The rotational elastoviscometer REV-2 operates similarly to the REV-1. The value of viscosity on these and other devices differed by no more than 6%. TAB

N66-12570# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GAUGE FOR MEASURING CONTINUOUSLY VARYING PRESSURE

V. N. Ovchinnikov 29 Jun. 1965 6 p Transl. into ENGLISH from Soviet Patent no. 146387 (Appl. no. 732231/40-23, 27 May 1961) 3 p

(FTD-TT-65-231/1+2+4; AD-620095)

Object of the invention: A device for measuring continuously varying pressure with a sensitive element designed in the form of a bellows or membrane connected to a string generator (slide-wire oscillator) which has the distinguishing feature that for the purpose of obtaining a linear dependence of the output parameter on the measurable value and continuous recording of the indications on an automatic writing device, in it there is used a feed voltage taken from the output of a string generator (slide-wire oscillator) driving a synchronous electric motor provided with a centrifugal regulator with the arm of which there is connected the pen of the automatic writing device. Author (TAB)

N66-12586# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.

NON-BLOOMING IMAGE ORTHICON Final Report, 1 Jul. 1963–31 Jan. 1965

J. Mueller [1965] 66 p refs

(Rept.-6; AD-621683)

A development program is presented for an image orthicon with a thin-film target and a triakali photocathode, with the capability of handling very high spot-illuminations in scenes of low general illumination. The 'Non-Blooming Image Orthicons' developed had the standard electroformed target-mesh replaced by a thick collector-mesh and a fieldmesh spaced 1 mm from the target. Major problems encountered that limited the investigation were target breakage and non-uniform electron penetration through the collector-mesh. Blooming measurements were performed with a special test-chart. Tubes were made that demonstrated only 1% loss in video information with spot-illumination at the photo-cathode at the 0.00001 foot-candle level. These figures are applicable only to measurements made with this test-chart, and substantially lower ratios are to be expected with real or simulated scenes of less than 100% contrast and bright spots of larger relative area. The best non-blooming characteristics were observed on thick-collector-mesh image orthicons with an integral target-field-mesh. TAB

N66-12595# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE GYROSCOPE IN GIMBAL SUSPENSION

Yevgeniy Leopol'dovich Nikolai 18 Aug. 1965 147 p refs Transl. into ENGLISH from the book "Giroskop v Kardanovom Podvese" Moscow, Izd. Nauka, 1964 136 p

(FTD-TT-65-416/1+2; AD-620837)

Contents: Differential equations of motion of a gyroscope in a gimbal mount; Stability of the axis of a rapidly spinning gyroscope; Pseudoregular precession of a gyroscope acted on by a constant moment; The case of constant friction at the gimbal axes. The representative point method; Elementary cases of gyroscope motion in the presence of friction at the gimbal axes; Small oscillations of a balanced gyroscope in the presence of friction at the gimbal axes; Pseudoregular precession of a gyroscope in the presence of friction at the gimbal axes; Motion of a gyroscope in the presence of friction forces proportional to the normal components of the dynamic reactions; Present state of the theory of the astatic gyroscope in a gimbal mount. TAB

N66-12596# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GYROSCOPIC HYDRAULIC DEVICE FOR MEASURING ANGULAR VELOCITY AND FOR DETERMINATION OF GEOGRAPHIC LATITUDE

L. I. Brozgul' 24 Aug. 1965 5 p Transl. into ENGLISH from the Soviet Patent No. 165319 (Appl. No. 783638/26-10, 19 Jun. 1962) 1 p

(FTD-TT-65-474/1+2+4; AD-620778)

In the proposed gyroscopic hydraulic arrangement an increase in measurement accuracy is attained thanks to the use of a cylinder, provided with radical channels, through which the liquid is forced by two counter streams. The operation of the device is based on the effect of Coroilis forces of inertia on the walls of the tubes, situated along the radii of the cylinder, when the liquid flows through the tubes. TAB

N66-12600# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A LENS COMPENSATOR FOR OPTICAL SYSTEMS WITH DOUBLE IMAGES, SUCH AS RANGE FINDERS

I. A. Greym 25 Aug. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 165317 (Appl. No. 855624/26-10, 5 Sep. 1963) 1 p

(FRD-TT-65-481/1+2+4; AD-620818)

In the proposed compensator in order to obtain reduced distances when measuring lines with small angles of inclination, for example with range finders of double image, one of the lenses is freely suspended in front of the second stationary lens in such a way, that the axis of lens suspension is displaced with respect to the sighting axis (optical axis of second stationary lens) by a magnitude, determinable by the given coefficient of the range finder. TAB

N66-12602# Naval Ordnance Lab., White Oak, Md.

ACCURACY AND CALIBRATION REQUIREMENTS OF OSCILLOSCOPE RECORDING SYSTEMS

Ronald B. Tussing Oct. 1965 39 p refs

(NOLTR-65-77; AD-620157)

The accuracy requirements for oscilloscope systems used to record transient pressures from underwater explosions are investigated. Systems and record reading accuracies are analyzed in detail to establish some basic requirements for calibration accuracies. The requirements are vertical calibration (Q-step), = 0.5 percent; horizontal calibration (time marks), = 0.015 percent. The time of rise and the decay time are defined for the Q-step; graphs and equations are developed for each. Actual experimental arrangements are considered to determine an acceptable range for the internal resistance of the Q-step generator and to show how the limits for the Q-step sweep speed should be found. The specifications for a Q-step generator are given and the merits of several circuits and techniques are discussed. A procedure for reading the Q-step record is included. Author (TAB)

N66-12615# Cubic Corp., San Diego, Calif.
SHIRAN GEODETIC SURVEY SYSTEM, ELECTRONIC AN/USQ-32(XA-1) FLIGHT TEST AND EVALUATION PROGRAM REPORT
Wright-Patterson AFB, Ohio, Res. and Technol. Div., Apr. 1965 157 p refs
(Contract AF 33(657)-7546)
(SEG-TDR-64-53; AD-619540)

Testing was accomplished over a six-station network extending from the southern part of Arizona to central Nevada. The photo test area, located near Phoenix, extended 34 miles north-south by 30 miles east-west. The flight test aircraft was an RC-130A. Line crossings were made over all 15 lines in the network and one over water line off Southern California. Data reduction gave a probable error for a line measurement (reduced to geodetic distance) of ±0.0011 nautical miles, well within the specification value of ±0.0017 nautical miles. Two photomapping flights were conducted. The internal consistency of SHIRAN gave an aircraft location of ±12.5 feet within 90 percent of the measurements. The agreement of aircraft location determined by SHIRAN with the position determined by reduction of the photographic data was ±21.6 feet for 90 percent of the measurements which satisfies the specification requirement of ±24 feet.
Author (TAB)

N66-12637# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRIAXIAL AUTOMATIC PHOTO-CAMERA FOR OBSERVING MAN-MADE EARTH SATELLITES
M. K. Abele 18 Aug. 1965 15 p refs Transl. into ENGLISH from Nablyudeniya Byul. (Spets. Vypusk) (USSR), no. 1, 1962 p 55–61
(FTD-TT-65-439/1+2+4; AD-620823)

A compensation method is used for satellite tracking with a photographic camera (f = 75 cm., D/f = 1:3.5, field of view 4° × 5°). A frame with the film placed in the focal plane of the objective lens vibrates in the direction of the track with the velocity of the image of the satellite. The vibrational motions of the frame as well as the rotation of the camera, the guiding and operating of the shutter are performed by means of an electronic programming device according to an approximate formula $\omega = \omega_0$ sq cor e. If the rotational velocity of the camera is not the same as that of the satellite a correction by hand can be made. Photographs of bright objects are taken on a fixed film with a rotating obturator. The time of observation is marked by means of a quartz clock. It is possible to track moving objects down to 10m, the internal error of position determination being =(0 min, 5 + 1 min).
Author (TAB)

N66-12699# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR RECORDING GAMMA TOPOGRAMS
E. Yu. El'kind and V. L. Krivoshein 29 Jun. 1965 8 p Transl. into ENGLISH from Sov. patent no. 162896 (Appl. no. 848948/31-16, 25 Jul. 1963) 3 p
(FTD-TT-65-209/1+2+4; AD-620997)

A device is proposed for recording gamma topograms which contains a scintillation pickup, a linear amplifier, a single-channel amplitude analyzer, a counting-speed meter, a system of control of the scintillation pickup, and a recording device, the distinguishing feature of which is that for the purpose of increasing the clearness of the 'scentigrams' and reducing the overall time of scanning by automatic regulation of the scanning step, in the apparatus there is included a relay-threshold electrical scheme which converts electrical pulses coming from a counting-rate meter into command signals to a system which decreases the scanning step in the passing of the scintillation pickup over the area with increased accumulation of radioactivity.
Author (TAB)

N66-12700# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR MEASURING THE DENSITY AND MOBILITY OF IONS IN THE ATMOSPHERE
Yu. A. Bragin 29 Jun. 1965 7 p Transl. into ENGLISH from Sov. patent no. 154066 (Appl. no. 780714/26-10, 31 May 1962) 3 p
(FTD-TT-65-207/1+2+4; AD-620996)

The device consists of two screened sieve-shutters placed in the inner cavity of a cylindrical intake attachment at a definite distance one from the other and perpendicular to its axis. The sieve-shutters are intended for measuring the speed of the drift of the charged particles by which afterwards there is calculated the mobility of these particles. The sieve-screens are intended for screening the effect of the electrical fields inside of the intake attachment on the outer medium and form a uniform electrical field in the area to be analyzed. The sieve-shutters represent tungsten filament-electrodes onto which there passes an alternating voltage creating a transverse electrical field attracting to itself electrons and ions in the course of all the time except moments of the passing through of a curve of alternating voltage, through a tension which is zero with relation to a given point of space. The sieve-shutters are connected up to a generator of AC, the frequency of which changes periodically with the aid of the commutator of frequency. On the bottom of the intake attachment there is fastened the collector, which catches the charged particles after they have passed through the two sieve-shutters. The ion flux is recorded by the electrometer, to the output of which there is connected the radio transmitter, which transmits to the earth the indications of the electrometer.
TAB

N66-12701# Joint Publications Research Service, Washington, D. C.
IZVESTIYA VUZOV: INSTRUMENT BUILDING, VOL. VIII, NO. 4, 1965
S. I. Zilitinkevich, ed. 25 Nov. 1965 182 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Priborostr. (Leningrad), v. 8, no. 4, 1965 p 3–145
(JPRS-33032; TT-65-33609) CFSTI: $5.00

Journal articles on radio electronic instruments, electric measuring instruments, instruments of automation and remote control, instruments of computer technology, gyroscopic and navigational instruments, optical instruments, thermal instruments, and general problems of instrument manufacture are presented. For individual titles see N66-12702–N66-12727.

N66-12702 Joint Publications Research Service, Washington, D. C.
A METHOD FOR THE PRECISION MEASUREMENT OF DELAY TIME
V. V. Molebnyy *Ih its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 1–8 refs (See N66-12701 03-14) CFSTI: $5.00

In this article, a method is considered for the precision measurement of delay time based on measuring the radiopulse repetition rate (period). Supplementary frequency modulation by the high-frequency filling of the radiopulses permits us to obtain a greater accuracy and resolving power for the method and also does away with the ambiguity in the measurement results.
Author

N66-12720 Joint Publications Research Service, Washington, D. C.

THE PHOTOELECTRIC METHOD OF MEASURING THE WORKNG SECTIONS OF PHOTOGRAPHIC OBJECTIVE LENSES

G. V. Belyakova *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 123–129 refs (See N66-12701 03-14) CFSTI: $5.00

In this article we consider a method of measurement, and a diagram and design of an instrument for quality control of working sections of photographic objective lenses in series production. The results of an experimental check of the instruments are given. Author

N66-12723 Joint Publications Research Service, Washington, D. C.

MEASUREMENTS OF RAPIDLY CHANGING TEMPERATURES OF GAS FLOWS WITH THE APPLICATION OF ELECTRONIC CORRECTION FOR THE THERMAL INERTIA OF THE HEAT DETECTOR

E. F. Simbirskiy *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 141–145 refs (See N66-12701 03-14) CFSTI: $5.00

The results of an investigation of the capabilities of electronic apparatus are given for automatic correction of the thermal inertia of wire heat detectors in measurements of rapidly changing temperatures of gas flows. Author

N66-12724 Joint Publications Research Service, Washington, D. C.

A THERMAL CONTACTLESS FLOWMETER WITH A CAPACITY OF UP TO 10,000 LITERS PER HOUR, WITH A SEMICONDUCTOR HEATER

P. A. Korotkov, D. V. Belyayev, and Ya. V. Rukin *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 146–150 refs (See N66-12701 03-14) CFSTI: $5.00

In this article the results of an investigation of a contactless thermal flowmeter measuring water for a pipeline with a diameter of 63 mm are given. The flow rates varied within limits of from 250 to 10000 liters per hour. Calibration graphs were obtained at various capacities of the semiconductor heater. Author

N66-12725 Joint Publications Research Service, Washington, D. C.

ON THE MAXIMUM POSSIBILITIES OF SHOCK ABSORPTION

Y. V. Guretskiy *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 151–156 ref (See N66-12701 03-14) CFSTI: $5.00

Exact formulas and evaluations have been obtained in the article for the minimum of the maximum deviation of a shockproof object placed on a movable base in the case of different laws of the change in the acceleration of the base (in the case of different forms of the shock pulse). Author

N66-12726 Joint Publications Research Service, Washington, D. C.

THERMOELASTIC STRESSES IN FERRITE COMPONENTS OF INSTRUMENTS AND RADAR DEVICES

Yu. M. Volokobinskiy *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 157–163 refs (See N66-12701 03-14) CFSTI: $5.00

Formulas are given in the article for the calculation of thermoelastic stresses in ferrite components. Author

N66-12757# Boston Coll., Chestnut Hill, Mass.

OPTICAL PERFORMANCE OF MULTI-CHANNEL UV AND VISIBLE SPECTROGRAPH Final Report, 1 Apr.–30 Jun. 1965

James J. Devlin 27 May 1965 30 p
(Contract AF 19(628)-4305; ARPA Order 254)
(AFCRL-65-477; AD-619496)

Optical performance tests were made on a multichannel UV and visible photographic spectrograph of the Ebert type which was designed and built by IIT Research Institute, Chicago, Illinois. The instrument was provided with several channels of fiber optics leading into the spectrograph entrance slit. These fibers could be directed at luminous sources at various special positions. It was determined that the spectral range was 2500A to 6500A, the average plate factor was 111A per mm, and the resolving power was better than 2A. It was shown that the field of view of each bundle of optical fibers provided excellent light collecting ability up to 12 deg. Each of the fiber bundles was approximately 0.254mm in diameter. The spectrograph accordingly met its optical design specifications. However, it was recommended that the open photographic reels be replaced by light-proof magazines. Author (TAB)

N66-12806# Metronics Associates, Inc., Palo Alto, Calif. Aerosol Lab.

THE INFLUENCE OF DAYTIME TRAVEL CONDITIONS ON THE DETECTABILITY OF FLUORESCENT PARTICULATE MATERIAL

Stuart W. Grinnell 30 Apr. 1965 50 p refs
(Contract DA-42-007-AMC-21(R))
(TR-115; AD-619769)

Inorganic fluorescent particulate material in the 0.5 to 10-micron size range has received wide usage as an atmospheric tracer material, since the collected particles are readily detected and counted under the microscope, using incident 3660 A illumination. Outdoor tracer comparisons have recently been reported in which there was a 50% loss of recognizable particles, probably due to deactivation by UV light from the sun at high atmospheric humidity. From laboratory tests, mostly on the activated zinc–cadmium sulphide materials, it is concluded that there is a wide range in stability among available materials, some of which are at least 10 times as stable as the materials used in the reported comparison. Author (TAB)

N66-12851# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

A HIGH SENSITIVITY HEAVY WATER LEAK DETECTOR

J. G. Bayly Oct. 1965 47 p refs
(AECL-2291) CFSTI: HC $2.00/MF $0.50

A process instrument for measuring changes in the D/H ratio of water has now passed from the experimental to the prototype stage. The infrared transmissions in a sample and in a reference stream are compared at two wavelengths to give an analysis which is insensitive to contaminants commonly found in water yet responds to 0.5 ppm D_2O near the natural abundance (150 ppm), and can have a range to at least 5000 ppm. At least thirty water streams can be analyzed per hour, and maintenance problems are expected to be negligible. Author

N66-12858*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.

ROCKET INSTRUMENTATION FOR THE MEASUREMENT OF D-REGION ELECTRON DENSITY AND COLLISION FREQUENCIES Scientific Report No. 244

T. A. Seliga, D. J. Hoffman, and J. S. Nisbet 1 Jul. 1965 25 p ref
(Grant NsG-134-61; Contract AF 19(628)-4050)
(NASA-CR-67957; AFCRL-65-673) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Experiment instrumentation designed to be flown in a Black Brant II rocket is described. The experiments are an AC conductivity probe, a low frequency propagation experiment, and a temperature probe. Functional block diagrams are given, and photographs of the probes as they are mounted on the nose-cone are included. Modifications to a remote control unit which monitors all the elemetry inputs in the blockhouse are also included. C.T.C.

N66-12867*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
LANGMUIR PROBES FOR MEASUREMENTS IN THE IONOSPHERE
L. G. Smith Oct. 1965 49 p refs Sumitted for Publication
(Contract NASw-1141)
(NASA-CR-68188; GCA-TR-65-25-N) CFSTI: HC $2.00/MF $0.50 CSCL 14B

The design and use of a DC probe for rocket measurements of electron density and electron temperature in the ionosphere is described. The probe is based on the Langmuir probe technique in a form which is particularly suitable for the investigation of features of the ionosphere involving steep gradients, such as sporadic E. The potential value of the probe in the D region is indicated. Author

N66-12931# Joint Publications Research Service, Washington, D. C.
COMPENSATED AND OHMIC MEASURING VOLTAGE DIVIDERS OF THE NIKOLA TESLA INSTITUTE
Zlatoje Zdravkovic and Dejan Skendzic 12 Nov. 1965 19 p Transl. into ENGLISH from Tehnika (Belgrade), no. 9, Sep. 1965 p 1736-1744
(JPRS-32843; TT-65-33421) CFSTI: $1.00

The article describes the compensated and ohmic dividers developed and designed to measure high shock voltages. In view of the difficulties encountered in any attempt to remain within the permissible limits of distortion in the shape of the voltage measured and amplitude error in the measurement of shock voltages of sharp slopes special attention has been devoted in the article to a description of the method of testing and the measurement of the characteristics of the dividers. The results of testing are given for all dividers along with conclusions in relation to scope and the potentialities of application. Author

N66-13029# Joint Publications Research Service, Washington, D. C.
DEVELOPMENT OF A HIGH-EFFICIENCY SATELLITE CAMERA AT THE INSTITUTE FOR PRECISION ENGINEERING OF ILMENAU TECHNICAL COLLEGE
P. Sollner 29 Nov. 1965 11 p refs Transl. into ENGLISH from Feingeratetechnik (East Berlin), v. 14, no. 9, 1965 p 401-404
(JPRS-33075; TT-65-33652) CFSTI: $1.00

Activities toward the development of a high efficiency camera are presented. The high speed cameras will be used to determine the trajectories of artificial earth satellites with increased precision of observation and range. A schematic diagram of the satellite camera in its developmental stage and a photograph of the model are shown. R.C.S.

N66-13111# Sandia Corp., Albuquerque, N. Mex.
SYNCHRONIZATION OF A FLASH LAMP AND MASS SPECTROMETER APPARATUS FOR FAST REACTION STUDIES
James M. Freese and Richard T. Meyer May 1965 18 p refs
(Contract AT(29-1)-789)
(SC-RR-65-185)

The development of instrumentation for achieving synchronization of events in flash photolysis/time-resolved mass spectrometry experiments is described. A general description of the complete apparatus is provided. In addition, detailed design and operational features of specially constructed synchronizing devices are included. Performance characteristics are discussed in terms of application of the system to a 20-kilocycle spectrometer frequency and a 25-microsecond flash duration. Extension of the apparatus to 100 kilocycles is considered. Author

N66-13143# Technology, Inc., Dayton, Ohio.
FLIGHT TECHNICAL ERROR OF GENERAL AVIATION AIRCRAFT
W. Wallace Morton, Jr., Cyril G. Peckham, and Joseph F. Braun, Jr. Jun. 1965 44 p
(Contract FA-WA-4542)
(RD-65-60)

This report presents a study of the flight technical error (random deviations from intended cruise altitudes) of six general aviation aircraft. Based in Ohio, Indiana, and New Jersey, these aircraft were a Beech C-45, a Bonanza H-35, an Apache PA-23-160, a Navion Rangemaster, a Cessna Skylane, and a Comanche PA-24-180. A total of 626 hours of cruise data was collected. A statistical analysis of the results is presented. Author

N66-13164*# Rocketdyne, Canoga Park, Calif.
AN INSTRUMENTATION SYSTEM TO STUDY ROCKET EXHAUST PLUME RADIATIVE PROCESSES Final Report
W. F. Herget et al 27 Aug. 1965 128 p refs
(Contract NAS8-11261)
(NASA-CR-68540; R-6288) CFSTI: HC $4.00/MF $1.00 CSCL 14B

The research, development, and modification of an instrumentation system to study processes affecting radiative heat transfer from the exhaust plumes of rockets utilizing LO_2/RP-1 propellants is reported. The instrumentation system is applicable to the study of the formation and distribution of carbonaceous radiative emitters and the location and progress of the exhaust afterburning. The principal components of the system are the model rocket motor with its associated hardware and instrumentation, the specially modified infrared spatially scanning spectroradiometer, the exhaust plume sampling probe, and the ultraviolet instrumentation, which includes the ultraviolet photographic pyrometer and the telespectrograph. The description of each of the major components of the system is accompanied by a discussion of the principles of their operation, an evaluation of their performance, examples of the results obtained, and recommendations for improvement. Applications of the instrumentation system to the study of radiative processes in rocket exhausts are discussed. Author

N66-13181# Atomic Energy Commission Research Establishment, Risö (Denmark). Health Physics Dept.
THERMOLUMINESCENCE READ-OUT INSTRUMENT FOR MEASUREMENT OF SMALL DOSES
J. Lippert and V. Mejdahl May 1965 14 p refs
(RISO-101) CFSTI: HC $1.00/MF $0.50

A thermoluminescence read-out instrument based on modulation of the light emitted by the luminophor during heating was designed and constructed. After amplification, the alternating signal from the PM tube is rectified by a phase-sensitive detector. By this method an effective reduction of the noise caused by the PM dark current was obtained. The performance of the instrument was tested with LiF (Harshaw, TLD 100) and $CaSO_4$: Mn luminophors. With $CaSO_4$: Mn an exposure of 5 μR of Co-60 gamma radiation could be measured with a standard deviation of 10%. The lower limit for LiF was approximately 1 mR. Various properties of the luminophors, including response characteristics, sensitivity to light and decay of stored energy, were investigated. Author (NSA)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-12199*# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
THEORETICAL AND EXPERIMENTAL STUDIES OF VISCO-TYPE SHAFT SEALS Semi-Annual Progress Report, Oct. 15, 1964–Apr. 15, 1965
William K. Stair 21 May 1965 27 p refs
(Grant NsG-587)
(NASA-CR-68220; ME-65-587-3) CFSTI: HC $2.00/MF $0.50 CSCL 11A

This report, the third of a series, outlines the progress made on an analytical and experimental investigation of the visco-type shaft seal. A critical review of all available data led to the identification of specific areas which require analytical and/or experimental study. Based on this study an experimental facility was designed to permit the experimental investigation of those problems relevant to the United States space activity. The test facility construction, which is essentially complete, is described. Author

N66-12210* National Aeronautics and Space Administration, Washington, D. C.
THE APPLICATION OF MATHEMATICAL METHODS IN SYSTEMS ENGINEERING
M. V. Savenkov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 59–66 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Application of methods of game theory and statistics make possible the introduction of quantitative characteristics for selected servicing systems for technical devices. This provides a basis for control of both the test parameters and technical devices. In schematizing the operation and services of the production problem, the exploitation of engineering may be considered a game between two players. Statistics are used to decrease losses by rational action, and many criteria can be used to build up strategy. A widely-used minimax principle always indicates a finite probability of failure in the technical device. The Bayyesovskiy principle is more applicable in selection of the service system. If the exploitation problem is regarded as a game with truncated sequential tests, a selection plan can be constructed to give the desired alternatives at each test step. Preparation and testing prior to use of a complex electronic device is discussed as an example of the application of statistical methods in systems engineering. M.W.R.

N66-12213* National Aeronautics and Space Administration, Washington, D. C.
AUTOMATIC HARMONIC ANALYSIS FOR MEASURING LOW-FREQUENCY PERIODIC LOADS IN THE PRESENCE OF HIGH-LEVEL DISTURBANCES
B. A. Barskiy and V. A. Volosevich *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 85–88 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

An harmonic analyzer has been developed which enables the measurement of periodic process from the frequency of an experiment, such as the frequency of the aerodynamic oscillations of the object in a flow when the coefficients for the rotational derivatives are determined. The use of rotating transformers makes the analyzer less sensitive to disturbances, and in such a device the filter is ahead of the amplifier. The actual model consists of a dynamometer with a strain gauge bridge, sine or cosine generator, amplifier, filter, voltmeter, peak-to-peak indicator, and nulling device. The transformer shaft is rotated by a drive powered by the oscillations of the test object, and the transmission is arranged so that the necessary harmonic is obtained. Three rotating transformers are used to obtain the coefficients of the first three harmonics. M.W.R.

N66-12218* National Aeronautics and Space Administration, Washington, D. C.
ANALYSIS OF INFORMATION OF THE SINTERING PROCESS OF IRON CONCENTRATES BY MULTIPLE CORRELATION METHODS
G. S. Nesterov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 110–115 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Statistical analyses using multiple correlation methods are applied to the indicators which characterize the sintering process of iron concentrates used to obtain raw materials suitable for blast furnace smelting. A quantitative evaluation is presented of the basic interrelations of the process; and an algorithm for utilizing the information is possible. Relationships between the investigated variables are tabulated, and a structural diagram of the sintering control system program is included. Results obtained are applicable to the operational analysis of production procedures, for development of high quality automatic control systems, and for simulating the sintering process control systems under laboratory conditions. M.W.R.

N66-12223* National Aeronautics and Space Administration, Washington, D. C.
PULSE METHOD IN THE NONDESTRUCTIVE CONTROL OF METAL PRODUCTS
A. T. Nikolayenko *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 147–151 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

In order to expand the use of pulse electroinductive devices (PED) in the nondestructive quality control of metal products, a scheme is presented which permits automatic analysis of the transient process for each of the control parameters. A differentiating unit obtains information on the rate of change of these transient processes. Industrial versions of PED's are being developed for quality control studies of tube with different profiles and metallic content. M.W.R.

N66-12224* National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF OPTIMUM FREQUENCY DURING NONDESTRUCTIVE CONTROL OF PIPE THICKNESS

A. T. Nikolayenko *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 152–157 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

A method to determine optimum frequency during nondestructive quality control of pipe thickness is based on the region of frequencies where there is a maximum ratio between relative sensitivities of the (1) measurement sensor with respect to variation in wall thickness and pipe and (2) oscillations of electrical conductivity or magnetic permeability of the pipe metal. Equations to determine relative sensitivity of the sensor to changes are evolved for the active component, reactive component, and modulus. Graphs indicate that relationship between sensor sensitivity and components remains constant up to frequencies where limiting values are achieved, which is up to 50 kc for active and 9 kc for reactive; for modulus, constancy remains up to 7 kc. M.W.R.

N66-12225* National Aeronautics and Space Administration, Washington, D. C.

AUTOMATIC PRODUCTION LINE FOR SECTIONS OF ELECTROLYTIC CONDENSERS

Yu. I. Baklanov, I. F. Ivlev, V. P. Shul'ts, G. S. Yeremenchuk, and N. I. Zubkov *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 158–163 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

An experimental operational automatic production line is described for winding of electrolytic condenser sections. While testing indicates that all the principal units are properly designed, some improvements are required to increase reliability. Problems also exist with regard to ease of operation. Test results for the first batch of condenser sections indicate a production tolerance of ±10% to be realistic; with improvements, tolerance can be reduced to ±5 to 7%. M.W.R.

N66-12226* National Aeronautics and Space Administration, Washington, D. C.

CONTROL SYSTEM FOR THE AUTOMATIC PRODUCTION LINE USED TO FABRICATE SECTIONS OF ELECTROLYTIC CONDENSERS

Yu. I. Baklanov, I. M. Filonenko, I. F. Ivlev, V. P. Shul'tz, G. S. Yeremenchuk et al *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec 1965 p 164–174 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Cyclogram, pneumatic and electric schemes, interlocking and signaling devices, and a special measuring device are considered for the experimental automatic production line for fabricating sections of electrolytic condensers. In order to produce the high winding accuracy required for the specified capacity, a wet winding process was tested. This method was not feasible because it increased errors in production. Instead, standardization is accomplished by cutting off the anode foil when the capacity of the section reaches a value less than the nominal value. The scheme for controlling winding is diagrammed. Testing results show that the error in condenser section fabrication does not exceed 10% in the case of condensers with a nominal capacity of 200 mf. Improvements in the system are needed to increase the quality of the condensers and to use less material during production. M.W.R.

N66-12227* National Aeronautics and Space Administration, Washington, D. C.

A MACHINE FOR THE CENTRALIZED AUTOMATIC CONTROL OF ALUMINUM PRODUCTION

V. P. Antipenkov, Z. M. Goldyreva, L. T. Gorokhovskiy, V. V. Ioannisvants, L. I. Mol't et al *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 175–182 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

General characteristics are given for an experimental machine which is designed to permit centralized automatic control of aluminum electrolysis equipment used in the production of aluminum. The machine, designated ERA-800, scans the production process, records the information obtained in digital form, and automatically controls the state of each electrolyzer according to the resistance of the interpole gap. It then determines and records in digital form the integral and average values of the process parameters. Operation of the machine is discussed as is the six-hour regulation cycle for monitoring one bank of aluminum electrolysis equipment. The experimental model is scheduled for operation in an automatic control system for the production of aluminum. M.W.R.

N66-12228* National Aeronautics and Space Administration, Washington, D. C.

A SYSTEM WITH AUTOMATIC SWITCHING FOR CONTINUOUS CONTROL OF COLD-ROLLED TRANSFORMER IRON

Yu. A. Vdovin and L. A. Polovnikova *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 183–189 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Since production control of cold-rolled transformer iron can best be achieved by magnetic induction measurements, a simple ac method was developed for making such determinations in iron sheets and rolls. A system was then designed to automatically control commutators and to measure magnetic induction continuously at a given field independent of oscillations in the voltage or transverse section of the iron sheet. Operation of this automatic control device is discussed, and processes which take place in the square-wave generator are illustrated. The instant of switching is shown to correspond to the position of the operating point on the descending branch of the demagnetization loop. A definite relationship exists between the induction on the descending and ascending branches of the dynamic loop; and this makes it possible to control the value of induction on the descending branch. Test indicate that when magnetization current varies up to 50%, the oscillations measure only 1 to 2% and cause errors in induction measurements of only 0.1 to 0.2%. M.W.R.

N66-12229* National Aeronautics and Space Administration, Washington, D. C.

AUTOMATIC MEASUREMENT OF PIPE LENGTH DURING THE PROCESS OF HOT-ROLLING

B. M. Sakandelidze and V. I. Khukhunaishvili *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 190–193 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

A device was developed to automatically measure individual pipe length during hot rolling as well as to control pipe dimensions, measure total length of piping rolled in a specified period, and record the total number of pipes during the same period. Operation of the device is described, and a block diagram of the system for measuring pipe lengths is included. M.W.R.

N66-12230* National Aeronautics and Space Administration, Washington, D. C.

MEASURING THE WEIGHT AND RATE OF POURING OF LIQUID STEEL INTO CASTING MOLDS

G. G. Bakradze *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 194–204 refs (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

Development of a control computer for the comprehensive automation of casting liquid steel is described. Operation principle of the control and measurement system is discussed

and a block diagram is included. Diagrams illustrate the relay blocking system of the measurement device, the lamp register commutator, and the differentiating unit. Design of dynamometers, which continuously weigh the ladles of liquid steel, is considered; ring force-sensing elements are used to smooth out the difference in variation of relative deformation. Five methods of installing dynamometers on the crane are given, with advantage, disadvantage, and specific application for each. Laboratory investigations show total error of ±0.5% or less of the measured value for temperature between −5 to +60° C. The relatively low stress in the force-sensing element lowers the shear stresses in the cement film and provides for minimum zero drift. M.W.R.

N66-12234* National Aeronautics and Space Administration, Washington, D. C.

MULTIPLE PHOTOCELL METHOD FOR AUTOMATING OPTICAL CONTROL

G. I. Batsevichyus, V. V. Neshukaytis, and Ya. Š. Storpirshtis *In its* Autom. Control and Methods of Elec. Meas., Vol. II Dec. 1965 p 230–235 (See N66-12201 03-10) CFSTI: HC $6.00/MF $1.50

The multiple photocell method of achieving optical quality control and sorting of sheet and ribbon products is discussed relative to the paper and textile industry. The advantages and disadvantages are discussed, and the general mode of operation is described. The method is given a brief theoretical treatment, and some experiments are cited. C.T.C.

N66-12344*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE ELECTROMAGNETIC HAMMER

Washington, NASA, Dec. 1965 28 p refs
(NASA-SP-5034) GPO: HC $0.25; CFSTI: MF $0.50 CSCL 13I

Magnetic coil design and development are discussed for an electromagnetic hammer. A method of using electromagnetic forces for removal of distortion from welded components is investigated. This method uses a pancake electromagnetic coil driven by electric-discharge equipment to correct distortion in components such as welded rocket fuel tanks, gore segments, and bulkheads. No tooling other than the magnetic coil is required. Manufacture and energy-carrying capacities of these experimental electromagnetic coils is discussed; and requirements for magnetic hammer design and operation are detailed. Characteristics of the coils used in the study are summarized. M.W.R.

N66-12366# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF BONDING RUBBER TO METAL

A. D. Poyarkova and V. L. Rozen 20 Sep. 1965 4 p Transl. into ENGLISH from Soviet patent no. 166821 (Appl. no. 854293/23-5, 24 Aug. 1963) 1 p
(FTD-TT-65-514/1+4; AD-621779)

The object of the invention is a method of bonding rubber to metal which consists in introducing into a rubber mixture a cobalt salt and placing it on the clean metal or metal previously covered by a solution of the same mixture containing a cobalt salt and then vulcanizing by the ordinary methods. Salts of alkaline metals are added to the rubber mixture to increase the strength of the bond with the metal. TAB

N66-12375# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POLYSILOXANES AS ANTIFRICTION AND ANTIWEAR ADMIXTURES TO PETROLEUM GREASES

G. V. Vinogradov, N. S. Nametkin, and M. I. Nosov 18 Jun. 1965 13 p refs Transl. into ENGLISH from Neftekhimiya (USSR), vol. 3, no. 5, 1963 p 792–798
(FTD-TT-65-316/1+2+4; AD-621008)

The use of polysiloxanes in combination with petroleum oils to achieve high lubricating qualities was investigated, as well as finding petroleum oil components most effective for this purpose. The results show that: (1) In a narrow range, polyethylsiloxane concentrations can be highly effective antiwear and antifriction additions to petroleum oils. (2) In the use of remnant oil MK-22, the highest applicability with respect to polyethyloxanes are demonstrated by fractions (obtained by absorption distribution over silica gel), enriched with hydrocarbons with a small number of aromatic rings in the molecules. (3) Conditions for the appearance of high activity of polyethylsiloxanes at heavy friction conditions are preliminary training of friction surfaces in polyethylsiloxane solutions in open air and sufficiently high concentration of oxygen in the friction zone. The mechanism of antifriction and antiwear effects of polyethylsiloxanes are determined by chemical processes during friction, which are connected with the decomposition of polyethylsiloxane in the friction zone and with the oxidation processes taking place on the friction surfaces. R.R.D.

N66-12510# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HIGH-TEMPERATURE TESTING DEVICE FOR DETERMINING THE DEFORMATION OF HEAT-RESISTANT MATERIALS AND THEIR TEMPERATURE

Ye. M. Bulysov, R. Ya. Drozdov et al 13 Aug. 1965 4 p Transl. into ENGLISH from Soviet patent no. 165562 (Appl. no. 833061/25-8, 25 Apr. 1963) 1 p
(FTD-TT-65-638/1+2+4; AD-620860)

The object of the invention is a high temperature testing device for determining the deformation of heat-resistant materials and their temperatures consisting of a water cooled cylinder provided with a slotted type graphite heater and a vacuum pump. For the purpose of determining the different structural changes in the material on heating, a calibrating specimen with a known coefficient of expansion is used which is made up in such a way that through it the edges of the tested specimen, placed together in one plane with the edges of the calibrating specimen, are observed. TAB

N66-12527*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

BEARING LIFE AND FAILURE DISTRIBUTION AS AFFECTED BY ACTUAL COMPONENT DIFFERENTIAL HARDNESS

Erwin V. Zaretsky, Richard J. Parker, William J. Anderson, and David W. Reichard Washington, NASA, Nov. 1965 21 p refs
(NASA-TN-D-3101) CFSTI: HC $1.00/MF $0.50 CSCL 13I

Rolling contact fatigue tests on 207 size deep groove ball bearings were analyzed to determine the relation between actual component hardness differences on bearing fatigue life and scatter. The tests were conducted at a radial load of 1320 lbs, which produced maximum Hertz stresses of 352 000 and 336 000 psi at the inner and outer races, respectively, at an inner race speed of 2750 rpm, and with a highly purified naphthenic oil as the lubricant. Results showed that for actual ΔH increments of 0.5 point Rockwell C, the maximum fatigue life was obtained for a ΔH range of 1.5 to 2.0 points Rockwell C where ΔH is the difference between the actual hardness of the rolling elements in the bearing and the actual hardness of the race. A relation is indicated between bearing fatigue life scatter and component hardness combination. For both full

scale bearings and the five ball system, fatigue scatter decreased with increasing ΔH until a minimum value was obtained at a ΔH of approximately 2 points Rockwell C. Bearings having a ΔH of between 1 and 2 points Rockwell C showed a potential of four to five times greater fatigue life than could be achieved with bearings manufactured with normal methods. R.N.A.

N66-12537# Shell Oil Co., Wood River, Ill. Research Lab.
STUDY OF HELICOPTER GEAR LUBRICATION Quarterly Progress Report, Jun.–Aug. 1965
D. R. Bailey, S. J. Beaubien, J. E. Bevel, and D. E. Stuart [1965] 22 p refs
(Contract NOw-65-0323-c)
(QPR-2; AD-621916)

Studies of the effect of gear-tooth surface pretreatments on gear performance were continued. Two surface precoatings, one obtained with Parco lubrite solution and one with trichloroacetic acid, were found to increase greatly the constant load gear fatigue life, the former consistently, and the latter under some conditions of operation. A 30% reduction in load with the untreated gears was necessary in order to achieve the same constant load life as obtained with Parco lubrite treated gears at 6400 rpm. In other experiments, improvement of the surface finish by lapping resulted in improvements in gear life of about two to four times that of the untreated gears, the greater improvement being a low speed. None of the pretreatments significantly affected the score load of a MIL-L-23699 oil. In break-in studies employing a loading schedule in which the load was increased stepwise, it was found that neither operation for a long prior period at low load nor elimination of the low-load steps had any significant effect on the eventual failure load, or the mode of failure. In tests with a synthetic base oil on the rotary contact simulator, in which various points on the gear tooth profile were simulated, immediate scoring occurred on the disks simulating the tips, and areas near the tips, of the pinion and gear addenda. In every case of scoring, the mating disks, representing the corresponding dedenda, had undergone considerable surface cracking and sometimes pitting. Between these extremities on the gear-tooth active profile no failures occurred. Author (TAB)

N66-12545# Naval Avionics Facility, Indianapolis, Ind.
THE NAFI THIN FILM IN-LINE VACUUM DEPOSITION PROCESS AND TECHNOLOGY
1 Jul. 1965 279 p refs
(TP-220; AD-621065)

The report contains information about the materials, equipment, and processes used in a pilot line production facility designed for the fabrication of thin film microelectronic circuits. The process selected for study utilizes a concept in which passive thin film circuit elements are vaporized in a vacuum chamber and deposited on a Pyrex substrate using a through-mask technique. This process is a semi-automatic operation with a potential of becoming fully automated. The equipment consists of four in-line vacuum deposition chambers, and associated pumping systems. Controls and monitoring devices are an integral part of the semi-automatic model. Materials used for circuit element fabrication are silicon monoxide, chromium, and copper, which are evaporated singly or in combinations. Significant improvements have been made toward the goal of continuous, in-line, semi-automatic fabrication of quality-controlled thin film circuits. A limiting factor in through-mask depositions had been the high cost of mask fabrication. The use of graphite masks has made the through-mask method economically feasible for the size and density of circuits being produced at NAFI. TAB

N66-12572# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
END SEALING OF A SHAFT
L. S. Arinushkin, A. Yu. Polinovskiy et al 26 Aug. 1965 5 p Transl. into ENGLISH from Soviet patent no. 134986 (Appl. no. 667368/25, 23 May 1960) 2 p
(FTD-TT-65-773/1+2+4; AD-621011)

The object of the invention is the end sealing of a shaft in the form of a ring turning together with the shaft, the ring sliding on the smooth motionless end surface to which it is pressed by a spring, bellows-type packing, and slotted centrifugal packing, formed by the ring gap between the bottom of a cup turning together with the shaft and the motionless end surface. For the purpose of releasing the sliding sealing at high angular velocity the jacket of the sliding ring has a conical end surface resting on balls which push it out under the action of centrifugal force. Author (TAB)

N66-12611*# Martin Co., Denver, Colo.
OPTIMIZATION OF HYDRAULIC THRUST VECTOR CONTROL SYSTEMS FOR LAUNCH VEHICLES, VOLUME III, SECTION 2
C. E. Jones Jan. 1965 445 p
(Contract NAS8-11415)
(NASA-CR-68093; Martin-CR-65-5, V-III, Sect. 2) CFSTI: HC $8.45/MF $2.25 CSCL 13G

Weight and reliability equations were derived for optimization computations of the following hydraulic thrust control components for launch vehicles: (1) in-line pump and intensifier; (2) airborne filters for various flow rates and system pressures; (3) reservoir-accumulators with a bootstrap piston area ratio of seventy to one; (4) tubing lengths for varying truss dimensions and actuator requirements; and (5) O-ring requirements. Unit and development cost equations for all applicable components were established under consideration of port size, rated pressure, rated flow, unit weight, etc. Derived cost equations for all components, except the actuators, included a fixed cost for acceptance testing and required technical support. Cost of the hydraulic system weight was determined for the system weight and the cost per pound of the stage being investigated. G.G.

N66-12727 Joint Publications Research Service, Washington, D. C.
THE CURVATURE OF THE FACES OF THE CURVED TEETH OF THE GENERATION-TYPE BEVEL GEARS AND DETERMINATION OF THE DIMENSIONS OF THE CONTACT PATTERN
A. A. Zaostrovskiy *In its* Izv. VUZov: Instr. Bldg., Vol. 8, No. 4, 1965 25 Nov. 1965 p 164–167 ref (See N66-12701 03-14) CFSTI: $5.00

An analytical method is examined in the article for determining the form and dimensions of the contact pattern on the faces of the curved teeth of the bevel gears. Methods are set forth for solving the problem on the curvature of the faces of the teeth and for determining the dimensions of the area of their instantaneous contact and also for determining the direction of the shift of this area on the face of the tooth. Author

N66-12729# Joint Publications Research Service, Washington, D. C.
FROM THE SOVIET DEBATE ON BRAZING
10 Nov. 1965 14 p refs Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 8, Aug. 1965 p 39–42 (JPRS-32802; TT-65-33380) CFSTI: $1.00

CONTENTS:

1. SHORTCOMINGS OF CERTAIN BRAZING OPERATIONS I. I. Il'yevskiy p 1–4 refs (See N66-12730 03-15)

2. MORE ATTENTION TO BRAZING PROBLEMS Yu. S. Dolgov p 5–8 refs (See N66-12731 03-15)

3. SOME REMARKS ON THE DISCUSSION OF BRAZING QUALITY A. I. Gubin p 9–11 ref (See N66-12732 03-15)

N66-12730 Joint Publications Research Service, Washington, D. C.

SHORTCOMINGS OF CERTAIN BRAZING OPERATIONS

I. I. Il'yevskiy *In its* From the Soviet Debate on Brazing 10 Nov. 1965 p 1–4 refs (See N66-12729 03-15) CFSTI: $1.00

A rebuttal to criticisms of a previously published article on brazing is presented, and a list of references to support the various observations on the role of the liquid phase in the breakdown of brazed joints is included. The need for quality control of published studies on brazing is pointed out. M.G.J.

N66-12731 Joint Publications Research Service, Washington, D. C.

MORE ATTENTION TO BRAZING PROBLEMS

Yu. S. Dolgov *In its* From the Soviet Debate on Brazing 10 Nov. 1965 p 5–8 refs (See N66-12729 03-15) CFSTI: $1.00

The increasing importance of brazing in many branches of technology is pointed out, and the need for improved personnel training is emphasized. Publication of a fundamental brazing handbook is proposed, and recommendations on its contents include sections on: (1) interaction of the liquid solder with the basic metal; (2) interaction of the solder and the basic metal with the surrounding gas or liquid medium; (3) modern nomenclature of solders, and of fluxes and gas media for brazing; (4) equipment, such as soldering irons, special burners, induction coils for high frequency heating, setups for electrocontact heating, furnaces, containers, and special setups; (5) general problems of brazing technology; (6) technology of brazing various materials; and (7) brazing economics. Three mechanisms are also proposed for evaluating the influence of various brazing parameters on the weakening of the basic metal under the action of solders. M.G.J.

N66-12732 Joint Publications Research Service, Washington, D. C.

SOME REMARKS ON THE DISCUSSION OF BRAZING QUALITY

A. I. Gubin *In its* From the Soviet Debate on Brazing 10 Nov. 1965 p 9–11 ref (See N66-12729 03-15) CFSTI: $1.00

Various contradictory studies on the basic theoretical problems of brazing are discussed, and the need for more refined brazing terminology is stressed. Research to determine the causes for the appearance of cracks in metal during brazing is recommended, although it is stated that their appearance is possible only in the case of liquid solder contact with a metal under tensile stresses. It is also pointed out that (1) available experimental data show that the greater the stresses, brazing temperature, and surface activity of the liquid solder, the greater the probability of crack formation and development; and (2) during the initial stage of the interaction, a layer is formed on the interface of the basic metal and solder. M.G.J.

N66-12764# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT ABRASIVE PROPERTIES OF STEEL EROSION PRODUCTS DURING ELECTROSPARK PROCESSING

N. V. Afanas'yev and A. G. Goloveyko 19 Aug. 1965 9 p refs Transl. into ENGLISH from Tsentr. Nauchn.-Issled. Lab. Elektr. Obrabotki Metallov (USSR), 1963 p 134–138 (FTD-TT-65-451/1+2+4; AD-620808)

An investigation was made of abrasive properties of metal powders, obtained by the electro-spark method. Investigated were steels 40KH, 2KH13, R18, and alloy T15K6, as well as boron and silicon carbides. Dispersion of these materials took place in kerosene with the aid of an electro-spark installation. The investigated material in amount of 100 mg, wettened by 2–3 droplets of water, was introduced between the glass and steel disks. The abrasive properties of the materials were measured by the wear of the glass disk after each 3000 revolutions and quantitatively evaluated on the basis of the following values: wear intensity of glass disk, representing the magnitude of wear, calculated per one revolution; by relative intensity of wear (ratio of wear intensity under effect of metal powders I_e to wear intensity under effect of boron or silicon carbidy powders I_k; and relative summary wear (ratio of summary wear under effect of metal powders within any given testing time to summary wear under effect of silicon or boron carbide powders during the very same testing time). TAB

N66-12797# Hamilton Standard Div., United Aircraft Corp., Broad Brook, Conn.

ENHANCED MICRO-MODULE INTERCONNECTIONS. AN HERMETIC PACKAGING SYSTEM FOR THE INTEGRATION OF MICRO CIRCUITS Final Report, 12 Jun. 1963–15 Mar. 1965

4 Mar. 1965 155 p refs

(Contract DA-36-039-AMC-03620(E))

(HSER-3078; AD-622256)

A pilot production capability was established to assemble 100 Enhanced Micro Modules per eight hour shift. The Enhanced Micro Module is an all electron beam welded, hermetically sealed interconnection packaging system which is compatible with all approaches to microminiaturization. The production capability was demonstrated by the assembly of Engineering Model Design Enhanced Micro Modules which are nonfunctional units designed to check a significant number of welds as well as the integrity of the structure before and after environmental exposure. Ten Stage Binary Divider Enhanced Micro Modules were assembled to demonstrate compatibility with monolithic integrated circuits. All the tools, fixtures, machines and processes were developed and are operational. Author (TAB)

N66-12803*# Stanford Univ., Calif. Dept. of Statistics.

STATISTICAL CONTROL OF A NORMAL PROCESS

Howard M. Taylor 7 Sep. 1965 24 p refs Supported by NASA, Army, Navy and AF

(Contract Nonr-225(53))

(TR-82; AD-622828) CFSTI: HC $1.00/MF $0.50 CSCL 13H

The optimal statistical control of a simple production process which has only two underlying states, in control and out of control, is studied. The produced items are assumed to have a measurable quality characteristic which has a normal distribution with known variance. When the process leaves control the mean of this distribution shifts from μ_0 to μ_1, both assumed known. Costs are associated with the quality of an item and with repairing the process which returns it to a state of control. Other than immediately after repair, the process state is assumed unknown. This report gives a statistical control rule which, based on the quality history of produced items, tells when to repair the machine. The rule given minimizes the time average of the total cost of repairs plus quality. Author

N66-12821 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CENTRIFUGAL TURBINE ROTOR BLADE

Yu. B. Kozlov 20 Sep. 1965 6 p Transl. into ENGLISH from Soviet patent no. 165038 (Appl. no. 849916/24-6, 29 Jul. 1963) 1 p
(FTD-TT-65-503/1+2+4; AD-621781)

The object of the invention is a centrifugal turbine rotor blade which has a thickness that becomes less in the axial direction. For the purpose of increasing the vibration strength of the rotor, the thickness of the blade in any cylindrical section is made to decrease in accordance with a parabolic dependence with the decreasing of the degree of the parabola with a decreasing radius of the cylindrical cross section. Author (TAB)

N66-12922# Bureau of Mines, Salt Lake City, Utah.
AN ECONOMIC AND TECHNICAL EVALUATION OF MAGNESIUM PRODUCTION METHODS. PART I: METALLOTHERMIC
Karl C. Dean, D. A. Elkins, and S. J. Hussey 1965 85 p refs
(BM-RI-6656)

This report is the first of a series concerned with processes for producing magnesium. These reports will evaluate metallothermic, carbothermic, and electrolytic production methods, and will furnish a cost basis for comparing the processes. Areas deemed most promising for future research will be delineated for each procedure. This report presents briefly the history of the metallothermic process, and describes the operations of the Defense Plant Corp. (DPC) plants that employed the process. A hypothetical plant designed to produce 12,000 tons of magnesium per year, using ferrosilicon as a reductant, is described, and raw materials, energy, and major equipment requirements are estimated. Several process modifications are suggested for future research. Author

N66-13013*# National Aeronautics and Space Administration, Washington, D. C.
LISTING OF SPECIAL PUBLICATIONS AND TECH BRIEFS
Nov. 1965 20 p CFSTI: HC $1.00/MF $0.50 CSCL 05B

This dual listing includes information from the nation's space program which is made available to American industry, including the latest developments in materials, processes, products, techniques, management systems, and analytical and design procedures. The Special Publications listing presents information derived from or of value to NASA activities, but does not necessarily report the results of individual NASA-programmed scientific efforts. These Special Publications include conference proceedings, monographs, data tabulations, handbooks, sourcebooks, and special bibliographies. The Tech Briefs are concise one or two page descriptions of NASA innovations arising from the space program and having possible applications in science, commerce, or industry; and they are published under the general categories of electrical (electronic), energy sources, materials (chemistry), life sciences, and mechanical. R.R.D.

N66-13056# Los Alamos Scientific Lab., N. Mex.
THE ALTERNATING CURRENT ELECTROETCHING OF ALPHA, DELTA AND BETA PLUTONIUM
K. Allan Johnson [1964] 14 p
(Contract W-7405-ENG-36)
(LADC-6691)

A new method of etching plutonium has been developed which uses alternating current electrolysis. The technique produces etched surfaces on alpha, delta, and beta plutonium and allows the microstructures to be revealed under bright field illumination. The method also preserves the form of alpha microcracks and delineates coring in stabilized delta and beta allotropes. Author

N66-13057# Los Alamos Scientific Lab., N. Mex.
ALTERNATING CURRENT POLISHING AND ELECTROETCHING OF METALS
Kaye Allan Johnson [1964] 18 p ref
(Contract W-7405-ENG-36)
(LADC-6407)

The alternating current etching of plutonium was investigated with respect to variation in solutions, voltages, and current densities. Also, other metals were examined with this technique. Data are tabulated. Photomicrographs of the specimens are included. The etching of plutonium was successful; however, only limited success was achieved with many of the other metals investigated. The four electrolytes used in the experiments are also given. E.E.B.

N66-13073# Bendix Corp., Kansas City, Mo.
SOLDERABILITY TESTING
William B. Harding Jul. 1965 40 p refs
(Contract AT(29-1)-613)
(BDX-613-73; CONF-650702-2)

The theory underlying solderability (wetting and penetration) is presented. Spread tests, dip tests, and penetration tests of solderability are reviewed and their limitations discussed. NSA

N66-13076*# Battelle Memorial Inst., Columbus, Ohio.
WELDING-BASE METAL INVESTIGATION Final Report, 27 Jun. 1964–28 Jul. 1965
D. L. Cheever, P. A. Kammer, R. E. Monroe, and D. C. Martin 28 Jul. 1965 217 p refs
(Contract NAS8-11445)
(NASA-CR-68412) CFSTI: HC $6.00/MF $1.25 CSCL 13H

A program was conducted to investigate the effects of factors associated with aluminum-base plate and filler wire on the occurrence of weld defects. The materials studied were experimental alloys of 2219-T87 and 2014-T6 base plate and 2319 and 4043 filler wire. In the program, four factors that determine the weld defect potential of a material were considered: (1) Chemical content, (2) Internal impurities, (3) Hydrogen content, and (4) External impurities. Chemical content is used to describe all the intentional alloy additions specified as ranges. Internal impurities were those elements limited by specifications to a maximum level. The hydrogen content was determined by vacuum fusion analysis. External impurities were used to describe the variation in hydrated surface oxide layers possible with aluminum. Actual control of external impurities was achieved by moisture additions to the weld shielding gas. Welds were made with the experimental plate and wire using precisely regulated welding equipment and accurate instrumentation. The welds were then examined by radiographic and sectioning techniques. In addition, a potential method of monitoring weld shielding gas purity is described. Author

N66-13096*# IIT Research Inst., Chicago, Ill.
GRAPHITE-METAL COMPOSITES Quarterly Report No. 1, 1 Aug.–1 Nov. 1965
Y. Harada 18 Oct. 1965 22 p refs
(Contract NASr-65(09))
(NASA-CR-68387; IITRI-G6003-1) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Equipment modifications for improved hot press processing were incorporated including the introduction of a constant pressure device. An improved venting system has virtually eliminated error inducing fumes in the optical pyrometry. Calibration of the hot pressing operation has shown that the sample

temperature is closely indicated by the present arrangement of a sight tube inserted into the mold. Attempts to hot press calcined petroleum coke at 3000° C with no metal additives produced highly graphitic structures which exhibit poor bonding. Studies of heterogeneity in densities of niobium and hafnium graphite composites showed that it is a result of carbide particle segregation. Examination of microstructures shows that denser sections contain larger and more numerous carbide grains. These sections probably contain amounts of metal in excess of the designed composition. Flexural strength either shows an inverse relation with density or is the same for different densities due to particle segregation. The usual direct relationship was not observed. Thus, higher density values alone are not always real indication of higher densification. R.N.A.

N66-13100*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Systems Div.
BERYLLIUM FABRICATION METHODS DEVELOPMENT PROGRAM: METAL REMOVAL
Apr. 1965 135 p
(Contract NAS8-11798)
(NASA-CR-68401; LMSC-A730586; SSD-11798-65-1) CFSTI: HC $4.00/MF $1.00 CSCL 13H

This report documents the metal removal techniques developed for the fabrication of beryllium aerospace vehicle structures. Proven production techniques for the drilling, routing, and abrasive wheel cutting of both sheet and plate gauges of material are presented. Established techniques for the precision machining of hot pressed block and extruded rod are reviewed. Chemical milling solution strengths and metal removal rates are investigated; and the optimum electrical discharge machining power and frequency settings, and electrode materials, are correlated with the resulting metal removal rates, surface finishes and elapsed machine times. Metallographic and microphotographic techniques were used for comparison and failure analyses. Author

N66-13127*# Westinghouse Electric Co., Pittsburgh, Pa. Astronuclear Lab.
BONDING OF A PYROLYTIC GRAPHITE HYPERVELOCITY IMPACT TARGET Final Report
H. C. Nicholson 15 Sep. 1965 13 p refs
(NASA Order C-67076-A)
(NASA-CR-54734; WANL-PR(FF)-001) CFSTI: HC $1.00/MF $0.50 CSCL 13H

This investigation involved a limited evaluation of two possible methods of joining annealed flat plates of pyrolytic graphite and the selection of a suitable method to fabricate a pyrolytic graphite hypervelocity impact target. A carbonaceous cement filled with powdered pyrolytic graphite was selected for bonding double shear specimens which were tested at room temperature in air and 1300° F in argon. The joint shear strengths obtained, averaged 100 psi and 120 psi at room temperature and 1300° F, respectively. A pyrolytic graphite target consisting of 15 individual plates was successfully bonded using the carbonaceous cement. Author

N66-13147# Pratt and Whitney Aircraft, Middletown, Conn. Canel Div.
OVERHUNG ROTOR DYNAMICS TESTS USING HYDROSTATIC WATER BEARINGS
D. A. Newey 24 Jun. 1965 51 p refs
(Contract AT(30-1)-2789)
(TIM-874)

This report describes the results of a rotor dynamics test with an overhung mass system using water as a lubricant, which is part of a liquid metal pump development program. Most of the work was directed toward finding a means of predicting and optimizing the conditions required to maintain stable rotation of the shaft. Bearing stiffness was evaluated by use of a hydraulic loading device. The relation between bearing stiffness and stability was studied by observing shaft whirl patterns. Low clearances were found to produce low whirl ratios and considerable hydrodynamic action at high speeds. Higher whirl ratios up to six were obtained by increasing the bearing clearance. The dynamic assembly consisted of a relatively stiff shaft supported by orifice compensated hydrostatic bearings. The amplitude of the synchronous whirl pattern at the system critical speed was found to be negligible due to high fluid damping characteristics. Author

N66-13171*# Stanford Univ., Calif. Dept. of Statistics.
COMPARISON OF SEVERAL PROCEDURES FOR PROCESS CONTROL Technical Report No. 84
Edward Pai-Chuen Kao 30 Sep. 1965 22 p refs Sponsored in part by NASA
(Contract Nonr-225(53))
(NASA-CR-68505) CFSTI: HC $1.00/MF $0.50 CSCL 13H

This paper compares three procedures for controlling a process: the Shewhart control chart, the cumulative sum chart, and the signed sequential rank procedure. When the mean of a process shifts by a large amount, the cumulative sum chart appears to be best. When deviations are small, the signed sequential rank procedure appears to be best. Author

N66-13189# Sandia Corp., Albuquerque, N. Mex.
ION PLATED COATINGS FOR THE CORROSION PROTECTION OF URANIUM
R. D. Bland, J. E. Mc Donald, and D. M. Mattox Oct. 1965 24 p refs
(SC-DR-65-519) CFSTI: $2.00

The feasibility of using the ion plating process to cast depleted uranium with relatively thin aluminum coatings was demonstrated. It was found that electropolishing is preferable to nitric acid dip for surface preparation prior to deposition of the coating, and that the uranium must be kept cool during the ion plating process to prevent surface oxidation. Ion bombardment followed by ion plating provided corrosion protection up to 96 hours exposure in a condensing water vapor atmosphere at 95° C. Various surface preparation techniques and deposition parameters are compared, and results indicate that standard vacuum deposition techniques do not provide adequate protection for uranium. Failure mode analysis shows that the vacuum evaporated coatings fail as a result of vapor penetration through pinholes in the film with subsequent interfacial corrosion and catastrophic adhesive failure. In the ion plated coatings, corrosion was confined to relatively small areas around the original pinholes even after extended exposure. M.G.J

N66-13194# Pratt and Whitney Aircraft, Middletown, Conn.
STRADDLE BEARING ROTOR DYNAMICS TESTS WITH STEP BEARING IN WATER
C. A. Merz 21 Jul. 1965 48 p refs
(Contract AT(20-1)-2789)
(TIM-921)

Preliminary results are given for straddle rotor dynamics tests of various journal bearing types for SNAP-50/SPUR liquid metal pumps. The test unit consisted of a vertical rigid rotor supported by two nonuniform clearance (step) bearings; a single pool hydrostatic thrust bearing supported the rotating

shaft assembly. Results indicate that the high damping of the shaft bearing resonance permits the pump to be designed for operations above the critical speeds. Experimental data are presented for the onset of unstable self-excited whirl; whirl ratios were measured. The effects of bearing supply pressure, water inlet temperature, shaft unbalance, and bearing housing flexibility are shown. Data indicate that housing flexibility can influence the onset of unstable self-excited whirl. Data comparisons demonstrate that four pool orifice compensated hydrostatic journal bearings have a greater region of stable operation than step bearings. D.T.

N66-13208# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVELOPMENT OF METHODS OF DEFECTOSCOPY OF METALS WITH APPLICATION OF GAMMA RADIATION
G. M. Luppov 30 Aug. 1965 14 p refs Transl. into ENGLISH from Trans. of the Inst. of Railroad Transportation Engr. (Moscow), issue 165, 1963 p 82–91
(FTD-MT-65-33; AD-621784)

The following methods of gamma-defectoscopy are discussed: photographic, ionization, xerographic, and television. TAB

N66-13225# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTRODUCTION OF A SYSTEM OF DEFECTLESS MANUFACTURE IN INDUSTRIAL PRODUCTION
A. S. Nefedov 10 Jun. 1965 9 p Transl. into ENGLISH from Byull. Tekh.-Ekon. Informatsii (Moscow), no. 2, 1965 p 10–12
(FTD-TT-65-549/1; AD-620098)

Systems planning is discussed relative to producing materials without defects. The methods are given in which preliminary information was obtained for organizing these systems. These include documentation at all stages of production, literature searches, and research. Improvements are reported, and specific examples cited. C.T.C.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-12270# Library of Congress, Washington, D. C. Aerospace Technology Div.
LASER-INDUCED NONLINEAR OPTICAL EFFECTS: COMPREHENSIVE REPORT Surveys of Soviet Scientific and Technical Literature
Yuri Ksander 29 Oct. 1965 52 p refs
(ATD-P-65-74)

Recent Soviet research dealing with laser-induced nonlinear optical effects, Raman scattering, and laser-induced gas breakdown is reviewed. Multiphoton processes, generation of harmonics, and the amplification and modulation of light in nonlinear media are discussed. Stimulated Raman scattering theory and applications to semiconductors and organic liquids are considered. M.W.R.

N66-12355# Electro-Optical Systems, Inc., Pasadena, Calif.
HIGH POWER LASER AMPLIFIER CHAIN TECHNIQUES First Quarterly Progress Report, 14 Jul.–14 Oct. 1964
G. L. Clark Griffiss AFB, N. Y., RADC, Sep. 1965 50 p refs
(Contract AF 30(602)-3502)
(EOS-5550-Q-1; RADC-TR-64-516; AD-621979)

This report describes work directed toward the development of an optical radar transmitter using the master oscillator-power-amplifier (MOPA) concept. The system will employ a CW YAG:Nd^{3+} oscillator and a chain of amplifiers, taking advantage of the power-handling capability of neodymium-doped glass to produce adequate power for long distance surveillance. Because a laser amplifies equally well in both directions and generates noise by spontaneous decay, careful design is necessary to avoid regeneration in the amplifier chain, prevent amplifier noise in the reverse direction from swamping the oscillator, control depumping caused by superradiance, and provide a good signal-to-noise ratio in the transmitted signal. This report includes discussion of cw oscillator and pulsed amplifier deisgns, measurements of amplifier gain, and calculations of the limitations imposed by superradiance. Author (TAB)

N66-12398# Hughes Aircraft Co., Culver City, Calif.
PULSED LASER OSCILLATOR ADVANCED DEVELOPMENT MODEL Fourth Quarterly Report, 1 Apr.–30 Jun. 1965
E. J. Woodbury Jul. 1965 6 p
(Contract DA-28-043-AMC-00326(E))
(ECOM-00326-4; AD-622268)

The report contains the supporting arguments for the change in direction of the contract from a 1500 pulse per second head to a 5000 pulse per second head, which change has just been negotiated. In addition, the results of some pertinent Company-sponsored work are given. Author (TAB)

N66-12450# Michigan Univ., Ann Arbor. Willow Run Labs.
SEMICONDUCTOR LIGHT SOURCES
Alfred E. Attard Sep. 1965 31 p
(Contract DA-28-043-AMC-00013(E)); Proj. Michigan)
(Rept.-6400-42-T; AD-470376)

The development of semiconductor light sources and the applications of such sources were the objectives of this project. Some 250 GaAs diodes were prepared, most of these exhibited injection electroluminescence, and a few appeared to be capable of producing coherent radiation. Modulation of the light output at frequencies up to 10 Mc/s has been achieved. Study of these semiconductor light sources for photographic recording of data at high information rates was undertaken. Recordable data at frequencies up to 350 Kc/sec have been demonstrated with possibilities of extending this capability into the megacycle range. Multielement light sources have been fabricated to demonstrate the possibility of simultaneous multichannel recording of data. Author (TAB)

N66-12553 Columbia Univ., N. Y. Plasma Lab.
APPLICATION OF THE QUENCHING OF He AND Ne METASTABLES BY OPTICAL RADIATION TO LASER MODULATION Quarterly Status Report
Thomas C. Marshall Apr. 1965 13 p refs
(Contract Nonr-266(93))
(AD-620436)

The pumping of metastables was done by visible radiation which stimulated transitions to the 2P levels. Recent experiments have shown that helium metastables were pumped by near infrared radiation, and the neon metastable population was reduced by the pumping process. The neon metastables were optically pumped with filtered visible radiation from a xenon flash lamp excited by a 100 J capacitor bank discharge. The laser output was quenched and was recovered to full value

after a time which depended on the initial laser intensity. The depopulation of helium ^3S metastables by infrared flash radiation were observed. These metastables were contained in the afterglow plasma of helium at a pressure ~5 mm Hg. When the infrared was filtered and visible flash-radiation was provided, no quenching was detected. It was noted that bombardment of the metastables with moderately energetic electrons will temporarily suppress the concentration of the neon metastables. R.W.H.

N66-12646 Library of Congress, Washington, D. C. Aerospace Technology Div.
ELECTRON-BEAM-PUMPED CdTe AND GaSe LASERS
Charles Shishkevish *In its* Foreign Sci. Bull., Vol. 1, No. 11 Nov. 1965 p 12–17 refs (See N66-12644 03-34)

The Soviet experimental research on recombination radiation of CdTe excited by a beam of electrons is reviewed. An operating electron-beam CdTe laser is described, as is the first III-VI laser pumped by a beam of electrons (GaSe). first III–VI laser pumped by a beam of electrons (GaSe).
Author

N66-12795# Ohio State Univ. Research Foundation, Columbus.
SOME STUDIES OF THE NEAR-HEMISPHERICAL RESONATOR GAS LASERS
F. G. Gebhardt 30 Oct. 1964 78 p refs
(Contract AF 33(657)-11195)
(Rept.-1641-6; AD-468328)

The problem of obtaining laser operation purely in the dominant transverse mode, as desired for heterodyning purposes, is considered here. The pertinent results of the resonator theory of Boyd, Gordon and Kogelnik are presented, along with the technique to be used for adjusting the hemispherical resonator laser for dominant mode operation and for identifying this condition using the photomultiplier beats between transverse modes. The experimental results, obtained using a commercially available gas laser, showed that pure dominant mode operation may be obtained at high excitation levels and that the technique of observing photobeats is necessary to accurately identify this condition. Also, the measured laser transverse mode beam patterns and resonant frequencies as deduced from the beat data, correlated well with those calculated from the optical resonator theory. Author (TAB)

N66-12799# Westinghouse Electric Corp., Pittsburgh, Pa. Quantum Electronics Dept.
INVESTIGATION OF THE USE OF A LASER AS A SPECTROGRAPHIC SOURCE Final Report, 1 Jun. 1964–31 May 1965
G. A. Klotzbaugh, A. L. Wolfe, J. E. Paterson, and T. A. Osial 30 Jun. 1965 102 p refs
(Contract AF 19(628)-4184)
(AFCRL-65-586; AD-622102)

The possibilities are studied of using a laser beam in spectrographic analysis. High intensity focused laser radiation is used to bombard various metal targets. An ionized plume is thereby produced, leaving behind a small crater in the target surface. This vapor is analyzed by a conventional spectrograph, thus producing a recorded spectrum that is characteristic of the target surface. This problem is studied both experimentally and theoretically, and it is concluded that best results are obtained when the plume is cross excited by a secondary source immediately after the laser generates the plume. Two types of lasers are used in the study. One is a normal laser having a few hundred spikes of energy in each pulse. The total pulse duration is of the order of a millisecond. The second type is a giant spike laser, in which all of the energy is released in one pulse of about a hundred nanosecond duration. The merits of each as spectrographic tools are discussed. Author (TAB)

N66-12814# United Aircraft Corp., East Hartford, Conn. Research Labs.
ULTRASONIC LASER MODULATION TECHNIQUES Final Report, 1 Jul. 1964–30 Jun. 1965
A. J. De Maria, D. E. Flinchbaugh, and G. E. Danielson, Jr. 20 Oct. 1965 119 p refs
(Contract DA-28-043-AMC-00259(E))
(D920259-12; AD-622575)

The feasibility of internally modulating the output of solid-state lasers without having to insert lossy elements into the Fabry–Perot feedback interferometer has been demonstrated by the propagation of focused acoustic waves within a glass laser rod. These studies have shown that the establishment of an alternating converging-diverging waveguide effect by the propagation of acoustic waves within the laser interferometer results in gating of a Nd^{3+} glass laser at the acoustic frequency, an increase in output energy by as much as 100%, and an absence of discrete axial modes under gating conditions. The complexity of the integral equations describing the slope and trajectories of light rays traversing various periodic refractive index variations generated by acoustic waves led to the use of analog computer techniques for solving three differential equations for the slope and trajectories of the light rays. The use of the slope solutions for designing a Fabry–Perot laser interferometer configuration for pulse shaping the output of laser oscillators is described. The trajectory solutions describe the operation of the converging–diverging waveguide modulation effect within the laser's interferometer. TAB

N66-12838# Electro-Optical Systems, Inc., Pasadena, Calif.
OPTICAL TRANSMITTER TECHNIQUES Technical Report, 15 Jul.–15 Oct. 1964
M. L. Bhaumik and L. J. Nugent Griffiss AFB, N. Y., RADC, Sep. 1965 17 p refs *Its* Rept.-5180-Q-2
(Contract AF 30(602)-3440)
(RADC-TR-64-526; AD-621630)

Work is described directed toward the design and fabrication of a gas laser oscillator and a solid-state chelate laser operating at wavelengths ranging from 5.0 to 0.3 microns. During the reporting period, the optimized material using sensitized fluorescence was tested for laser action. Under the high energy intensities of flashes, photo-reaction products are detected. This problem has been solved using new sensitizers and/or new solvents. But the quantum field is somewhat low with these sensitizers. Work is in progress to improve the quantum field. The mechanisms of the energy transfer in chelates have been further clarified and it is shown that the optical pumping scheme in the rare-earth chelate to achieve population inversion does not involve any inefficient process. Author (TAB)

N66-12860*# Arkansas Univ., Little Rock. Graduate Inst. of Tech.
INVESTIGATION OF LASER PROPERTIES RELEVANT TO THE MEASUREMENT OF DIFFERENT PHYSICAL PARAMETERS Semiannual Status Report, 1 Mar.–1 Sep. 1965
M. K. Testerman 11 Oct. 1965 65 p refs
(Grant NsG-713)
(NASA-CR-68235) CFSTI: HC $3.00/MF $0.75 CSCL 20E

Research is reported in the following areas: mapping of vibrating surfaces, the use of a laser to measure the frequency

response of a transducer, a sensitive level, a long path cell for the measurement of weak optical rotation, an angular alignment device, holograms, and pressure determination by Rayleigh scattering. Progress in each area is described in detail, and schematics are included. Conclusions are given along with areas of future work. C.T.C.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-12178*# Martin Co., Orlando, Fla.
ESTABLISHMENT OF STANDARDS FOR COMPATIBILITY OF PRINTED CIRCUIT AND COMPONENT LEAD MATERIALS Final Report, 27 Jun. 1964–27 Oct. 1965
W. R. Hutchinson, L. G. Hall, S. C. Osborne, and D. J. Collins
Oct. 1965 140 p refs
(Contract NAS8-11474)
(NASA-CR-68279; OR-6608) CFSTI: HC $4.00/MF $1.00 CSCL 11F

Reports and papers from industry and government were screened for welding and soldering processes, and materials for wires and other components of printed circuits and component lead materials were evaluated. Torsion shear type tests, flow soldering to a copper land on printed circuit boards, non-destructive droplet tests, and photomicrograph methods were used for material screening tests. Lead materials selected as most desirable for soldering were: (1) gold plated copper—60/40 hot dipped; (2) Dumet—60/40 hot dipped; (3) gold plated copper—electro-tin plated; (4) Dumet—electro-tin plated; and (5) Kovar—gold plated. G.G.

N66-12249*# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A STUDY OF TUNGSTEN–TECHNETIUM ALLOYS Quarterly Progress Report, Jul. 1–Oct. 1, 1965
Oct. 1965 9 p Sponsored by NASA
(Contract AT(45-1)-1830)
(NASA-CR-68105; BNWL-162) CFSTI: HC $1.00/MF $0.50 CSCL 11F

In an effort to eliminate porosity observed in the arc cast material, remelting of two pure tungsten and the 5, 10, 20, and 30 at. % Tc alloys was begun, using a 10 kW electron beam evaporator unit. Several melts of a W-25 at. % Re alloy were also made to improve the melting technique; radiographs revealed no internal porosity. To determine compositions within the second phase regions, arc melted alloys containing 50 at. % and 60 at. % Tc were examined with an electron beam microprobe. From these observations and the measurements made, findings indicate that the nonequilibrium structure of both alloys is alpha solid solution plus a region of alpha and sigma. The configuration of the second region appears eutectic and it is the last region to freeze; this interpretation places the 60 at. % Tc alloy as hypoeutectic. M.G.J.

N66-12256*# ManLabs, Inc., Cambridge, Mass.
ANALYSES OF VAPORIZATION IN LIQUID URANIUM BEARING SYSTEMS AT VERY HIGH TEMPERATURES
L. Kaufman and E. T. Peters Washington, NASA, Dec. 1965 32 p refs
(Contract NAS3-7168)
(NASA-CR-353) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Selection of a liquid uranium-bearing material system is considered as a heat exchanger for hydrogen gas at 100 atm pressure and 8000 to 10000° R. Metals for the selected systems, Zr–C–U and Nb–C–U, exhibit low atomic weight, refractoriness, low activity, and low nuclear capture cross sections. Potential of other systems, including the use of boron and a W^{184}–C–U alloy, is discussed. Partial pressures of Zr–C and Nb–C are plotted as a function of alloy composition at 9000° R, and vapor pressure data are given for carbon polymorphs. M.W.R.

N66-12264*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
STUDIES OF ALKALI METAL CORROSION ON MATERIALS FOR ADVANCED SPACE POWER SYSTEMS Quarterly Progress Report No. 4, Mar. 26–Jun. 26, 1965
R. W. Harrison [1965] 47 p refs
(Contract NAS3-6012)
(NASA-CR-54476) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Influence of stress on corrosion behavior of an advanced refractory alloy in potassium and corrosion mass transfer effects in a stainless steel-niobium alloy-potassium system were investigated. Two niobium-base alloy stress corrosion reflux capsules were heat treated for one hour at 2400° F. Since creep rate measurements indicated a faster rate at 2250° F than expected from pre-test uniaxial creep data, a temperature of 2100° F was selected to give the desired 5–10% creep strain for 500 to 2000 hr operation. With 430 hr test time accumulated, creep strain has reached 2–3%. Metallographic examination indicates no changes in one type of capsule (321SS), but two distinct layers, believed to be NbC and Nb_2N, in the other (316SS). Gross sensitization and sigma phase occurred in the latter; and stress-rupture testing of Nb–1Zr specimens indicates the effects of carbon and nitrogen mass transfer. Post-test evaluation shows significant advantage of the Type 321SS capsule over the Type 316SS with respect to C and N transfer. M.W.R.

N66-12277# Pratt and Whitney Aircraft, Middletown, Conn.
PHASE DIAGRAM OF THE Cb–Zr–C SYSTEM AT 1538C AND 1092C
James A. Cornie, Eugene J. Delgrosso, and Roger Granger
Oct. 1965 60 p refs
(Contract AT(30-1)-2789)
(PWAC-461)

The 1538° C isotherm of the columbium corner of the Cb–Zr–C system was determined. Two methods were used to identify the phases present in alloys representative of this section of the ternary diagram: X-ray diffraction of extracted phases, and chemical analysis of electrolytically extracted phases. The oustanding feature of this corner of the ternary diagram was the three-phase triangular region consisting of: (1) a Cb–Zr body centered cubic solid solution containing 1.3 w/o (1.3 a/o) Zr and less than 200 ppm C, designated as beta; (2) a (Cb, Zr) C_{1-x} face centered cubic phase containing 44.7 w/o (29.5 a/o) Zr and 7.64 w/o (39 a/o) C, designated as gamma; and (3) a $(Cb, Zr)_2C$ hexagonal phase containing 5.15 w/o (3.7 a/o) Zr and 6.15 w/o (33.62 a/o)C, designated as delta. The γ phase represents a continuous series of solid solutions between CbC_{1-x} and ZrC_{1-x}, respectively. The lattice parameters of the δ phase varied between: C_o = 4.965Å, a_o = 3.133Å at the 0 w/o Zr level and C_o = 4.985Å, a_o = 3.132Å at the 4.91 w/o Zr level. A similar but much less extensive determination of the 1092° C isotherm was made in order to delineate phase field boundaries at this temperature. Author

N66-12289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BERYLLIUM AND ITS ALLOYS IN AVIA INDUSTRY
Karel Straka 9 Jun. 1965 25 p refs Transl. into ENGLISH from Vyzkumny a Zkusebni Letecky Ustav (Czechoslovakia), no. 5, 1963 p 39–45
(FTD-TT-64-1027/1+2; AD-470330)

Basic data on beryllium and its alloys are reviewed, and its growing importance as an aviation construction material is emphasized. Details are given on manufacturing processes; raw materials; and melting, casting, forming, and powder metallurgy techniques. Tabulations are included on the physical and mechanical properties, classified according to the particular manufacturing technology employed. The basic deficiencies of beryllium are discussed, and structural applications of beryllium and its alloys are summarized. M.G.J.

N66-12357# Army Materials Research Agency, Watertown, Mass. Materials Research Div.
A RELATION BETWEEN MAXIMUM LOAD AND NECKING IN A TENSILE TEST AND A NECKING CORRECTION FOR FLOW STRESS
Albert A. Warnas Oct. 1964 15 p refs
(AMRA-TR-64-35; AD-621220)

Experiments on soft SAE 1018 steel have shown general agreement with formulae proposed by Beeuwkes stating that incipient necking occurs at a significant strain beyond the maximum load in body-centered cubic metals during a tensile test. The Bridgeman necking correction formula (using $e-e_n$ equal to a/R) applied from incipient necking was not in as good agreement with the experimental data as that of Beeuwkes. The results obtained justify a straight-line extrapolation of the true stress true strain curve to represent the corrected low stress flow strain values from the incipient necking point to fracture when the curve is plotted on a semiarchyperbolic sine graph. Author (TAB)

N66-12372 Joint Publications Research Service, Washington, D. C.
RELATIONSHIP BETWEEN THE MORSE POTENTIAL FUNCTION AND THE TEMPERATURE OF THE CRITICAL SHEAR STRESS OF AN IRON MONOCRYSTAL
Ch'i-Wei Lung, Pen-San Tsou, and Chien Chiang *In its* Transl. on Communist China's Sci. and Technol., No. 234 8 Nov. 1965 p 68–75 Presented at the Electron Theory of Metal Symp., Changchun, China, Aug. 1964 (See N66-12367 03-34) CFSTI: $3.00

The Morse potential function is used to make numerical calculations which are then compared with experimental data of the iron monocrystal. It is shown that the temperature-dependent relationship of the critical shearing stress of the iron monocrystal is in close agreement with the regularity, as deduced by the bonded force model coinciding with the atomic bond. R.R.D.

N66-12383# Ohio State Univ. Research Foundation, Columbus. Dept. of Physics.
THERMAL AND ELECTRICAL CONDUCTIVITIES OF Mo-Re ALLOYS IN THE SUPERCONDUCTING AND NORMAL STATES
J. G. Daunt Jul. 1965 37 p refs
(Contract Nonr-495(20))
(TR-16; AD-619719)

The paper gives details of the research carried out on the low temperature properties of Mo–Re alloys in the superconducting and normal states. Measurements were made on a variety of Mo–Re alloys in various states of anneal, the alloys being in the form of fine wires, as suitable for the winding of high-field superconducting solenoids. Micrograph studies were made to determine the percentage of the various phases present in each specimen. The low temperature measurements covered observations on the various specimens of the electrical resistivity as a function of temperatute and of magnetic field and the thermal conductivity also as a function of temperature and magnetic field. The measurements yielded evaluations of two of the three critical magnetic fields, H_{c2} and H_{c3} as a function of temperature and alloy constitution, the transition temperatures T_c and the Landau-Ginsburg parameter k. Detailed comparisons of the results are made with theoretical predictions and with results by previous authors on similar high-field superconducting alloys. Author (TAB)

N66-12389# Universidad Nacional de Cuyo, San Carlos de Bariloche (Argentina). Instituto de Fisica.
PLASTIC DEFORMATION ON ORDERED SOLID SOLUTIONS AND ITS EFFECT IN PHYSICAL PROPERTIES Final Report
Aldo E. Vidoz Washington, D. C., Army Dept., Sep. 1965 23 p refs
(Grants DA-ARO-49-092-63-12; DA-ARO-49-092-64-G36)
(AD-621077)

Single crystals of Ni3Fe were analyzed, chemically, by optical microscopy and X-ray diffraction: Specimens were annealed in vacuum at 850C and quenched. Tests were then made of tensile strength. Experimental results of yield stress and resolved shear stress were presented. Deformation curves are plotted for the ordered and disordered alloy. Shear stress vs shear strain is shown graphically. Discussion of results, to include experiments still in progress, cover yield strength and work hardening. Reference is made to investigation of high temperature creep in these alloys. Resistivity measurements were made and are discussed from viewpoints of short time and long time kinetics. Author (TAB)

N66-12494# Lockheed Missiles and Space Co., Sunnyvale, Calif.
FRACTURE TOUGHNESS OF X7039-T6 ALUMINUM ALLOY PLATE WELDMENTS Final Report
A. T. D'Annessa Apr. 1964 40 p refs
(LMSC-6-62-64-6)

This report is concerned with the fracture toughness evaluation of 1/2 inch plate weldments of X7039-T6 aluminum alloy using the precracked Charpy impact test technique. Fracture toughness data are presented for two and single pass welds, for weld and heat affect zone specimens at room and liquid nitrogen temperatures, and for the unaffected aluminum alloy temper base metal condition. Discussions of fracture toughness profiles of the weld and heat affected zone, the influence of temperature on the shift of the plane stress speak, and the effects of temperature rise in liquid nitrogen and liquid helium cooled specimens are also included. Critical crack sizes are calculated for the least tough weld location for room temperature and −305° F test temperatures, and for two base metal orientations. Author

N66-12495# Lockheed Missiles and Space Co., Sunnyvale, Calif.
FRACTURE TOUGHNESS OF X7005-T6351 ALUMINUM ALLOY PLATE WELDMENTS Final Report
A. T. D'Annessa Jul. 1964 27 p refs
(LMSC-6-62-64-10)

This report is concerned with the "precracked-Charpy" fracture toughness evaluation of 3/4" X7006-T6351 plate and its weldments. Fracture toughness, $(W/A)_c$, data at room temperature and LN_2 temperature are presented for four principal notch orientations in the base-metal and two weld fusion zone directions to assess resistance to longitudinal and transverse weld cracking. The variation of fracture toughness of sub-thicknesses of the basic plate thickness in both the base metal and weld fusion zone is determined by using varying width "through-thickness" notched specimens. "Through-thickness" notch data are used to calculate critical-crack size for two base-metal and two weld-fusion zone orientations. Critical-flaw sizes are calculated for both room-temperature and LN_2 temperature. The fracture toughness of the X7006 alloy is compared with that of the X7039 alloy reported in an earlier report. Author

N66-12500# Pratt and Whitney Aircraft, Middletown, Conn.
HIGH TEMPERATURE TITANIUM ALLOY DEVELOPMENT
E. J. Delgrosso, J. J. Kaminsky, and L. M. Raring Oct. 1965 31 p refs
(Contract AT(30-1)-2789)
(PWAC-472)

The objective of this work was to develop a titanium base structural alloy with useful properties of 1200° F. A number of solid solution–dispersion strengthening combinations were investigated. Most of these were alpha alloys but a few beta-isomorphous types were also evaluated. The most promising results in the alpha compositions were shown by alloys in the range Ti-(5-7) Al-(1.5–4.0) Zr-(0.2–0.4) C. The best combination of strength and ductility was achieved when material was worked entirely below the beta transus and then heat treated to produce a fine carbide dispersion. Rupture life at 1200° F and 30 000 psi was comparable to austenitic stainless steel. Consumably melted ingots, up to four inches diameter, were extruded to rod or forged and rolled to sheet. Alpha alloys in the Ti–Al–W–B and variations thereof were also investigated but to a lesser extent. Preliminary data was encouraging. The best beta composition was an alloy of Ti-(25–35)V-(6–10)W-(4–6)Al–(2–4)Zr–(.1–.4)C. More exhaustive fabrication and test evaluation is needed to assess the engineering merits of these alloys. The composition ranges, particularly within the alpha region, indicate the potentialities of titanium base alloys for service at 1200° F. Author

N66-12509# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FREE-CUTTING STAINLESS STEEL
N. M. Pisarev and V. M. Kozhin 27 May 1965 5 p Transl. into ENGLISH from Soviet patent no. 155813 (Appl. no. 779510/22-2, 18 May 1962) 2 p
(FTD-TT-65-487/1; AD-620079)

The object of the invention is a free-cutting stainless steel containing 0.35–0.45% carbon, 16–18% chromium, 1.5–2.5% nickel, 0.7–1.2% manganese and up to 0.5% silicon is distinguished by the fact that, in order to enhance the mechanical and anticorrosion properties, 0.7–0.9% molybdenum, 0.15–0.25% sulfur and 0.08–0.15% phosphorous are introduced. TAB

N66-12639# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
LOW-TEMPERATURE MECHANICAL PROPERTIES AND FRACTURE TOUGHNESS OF Ti-6Al-6V-2Sn
Thomas S. De Sisto and Charles F. Hickey, Jr. Jul. 1965 15 p refs Presented at the Ann. Meeting of Am. Soc. for Testing and Mater., Lafayette, Ind., 17 Jun. 1965
(AMRA-TR-65-17; AD-620745) CFSTI: $1.00

The mechanical properties of Ti-6Al-6V-2Sn have been evaluated in the temperature range from +200 to −269° C. A commercial and an extra-low interstitial (ELI) grade of the alloy were studied in both the as-received and heat-treated conditions. The ELI grade was heat treated to two different microstructures each having a yield strength level from 170 to 180 ksi. The data show that fatigue cracks severely reduced the notch strength and resulted in lower K_{Ic} values than when sharply machine notched. The material treated at the higher solution temperature exhibited higher K_{Ic} values than that heat treated at the lower solution temperature, despite the higher alpha-beta ratio of the latter condition. Author (TAB)

N66-12640# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Materials Engineering.
MEASUREMENT OF WELD THERMAL CYCLES IN 2-INCH TITANIUM PLATE Final Technical Report
Warren F. Savage and Yoshikuma Ishikawa 1 Jan. 1964 42 p refs
(Contract N161-25452)
(AD-620743)

In order to get basic data for welding, thermal cycles were determined for points adjacent to metallic-arc-welds in 2-inch Ti-5Al-2.5 Sn alloy plate, for last-pass and midplate positions, at energy inputs of 17.5 to 28.4 kilojoules per inch with preheat temperatures of 75 to 300° F. These data were presented in a general form to permit calculation of the instantaneous temperature at any time and distance from the weld centerline for any given welding conditions of an arc weld in 2-in. Ti5Al-2.5 Sn alloy plate. Furthermore, it is anticipated that these data will be applicable to many titanium-base alloy plates thicker than 1 inch without any significant errors. Author (TAB)

N66-12734# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BUILDING STRUCTURES FROM ALUMINUM ALLOYS Collection of Articles
S. V. Taranovskogo, ed. 27 Jul. 1965 398 p refs Transl. into ENGLISH of the book "Stroitel'nyye Konstruktsii Iz Alyuminiyevykh Splavov" Moscow, Gosstroiizdat., 1962 p 1–339
(FTD-MT-64-156; AD-620816)

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19. PRESTRESS OF OPEN TRUSSES FROM ALUMINUM ALLOYS FOR INDUSTRIAL BUILDING B. A. Speranskiy and F. F. Tamplon p 354–371 refs

20. ON QUESTION OF DETERMINATION OF COST OF PRESSED PROFILES FOR BUILDING PARTS N. G. Malinina p 372–378 refs

N66-12735 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BASIC PROBLEMS IN PREPARATION FOR BROAD APPLICATION OF ALUMINUM ALLOYS IN CONSTRUCTION

S. V. Taranovskiy *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 1–23 (See N66-12734 03-17)

Basic problems in the use of aluminum alloys for construction are examined. Discussions are included on the selection of brands of aluminum alloys and types of joints for building structures, the manufacture of semifinished aluminum alloy products and structures, the corrosion resistance of aluminum alloys, and certain peculiarities of aluminum alloy structures with respect to calculating ultimate strains and stability. R.N.A.

N66-12736 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONTEMPORARY ALUMINUM ALLOYS

I. N. Fridlyander *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 24–52 ref (See N66-12734 03-17)

The properties of various contemporary aluminum alloys are described. Included are alloys of Al–Mn, Al–Mg, Al–Mg–Si, Al–Zn–Mg, Al–Zn–Mg–Cu, Al–Mg–Si–Cu, Al–Cu–Mg, and Al–Cu–Li–Cd–Mn. Properties of founding aluminum alloys, baked aluminum powders and alloys, and foam aluminum are also discussed. R.N.A.

N66-12737 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF PHYSICO-MECHANICAL PROPERTIES OF ALUMINUM ALLOY D1-T, D16-T, AMg61, AND D16-A(g/k)

L. P. Shelestenko and Yu. M. Nagevich *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 69–90 refs (See N66-12734 03-17)

The physio-mechanical properties of the aluminum alloys D1-T, D16-T, AMg61, and D16-A(g/k) were investigated. The specific properties studied include limit of proportionality, yield point, ultimate strength, elastic modulus, specific elongation, and reduction of area. The properties were determined by tensile and compression tests. Test results are discussed and compared. R.N.A.

N66-12738 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF MECHANICAL PROPERTIES OF CERTAIN ALUMINUM ALLOYS UNDER TENSION AND COMPRESSION

Yu. S. Mkrchants *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 91–98 ref (See N66-12734 03-17)

The mechanical properties of sheets of aluminum alloys D16-T and AMg6 were investigated under conditions of tension and compression. The properties studied include conditional yield points, limits of proportionality, and longitudinal elastic moduli for tension and compression, and ultimate strength and specific elongations for tension. Work diagrams were prepared showing compression and tension curves of the alloys. A comparison of tension and compression curves for the D16-T alloy shows that they do not coincide especially in the section above limit of proportionality, where transition of the compression curve in the region of nonelastic deformations is smoother than for the tension curve. Tension and compression curves for the AMg6 alloy are analogous. Values for limits of proportionality and fluidity during compression are smaller than during tension for the D16-T alloy and approximately equal for the AMg6 alloy. Values for moduli of longitudinal elasticity during tension and compression for the D16-T and AMg6 alloys are approximately equal. R.N.A.

N66-12739 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CORROSION RESISTANCE OF ALUMINUM ALLOYS IN BUILDING STRUCTURES

Yu. N. Tikhenko and V. Ya. Flaks *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 99–132 refs (See N66-12734 03-17)

Corrosion data on aluminum alloys in building structures and the results of corrosion tests conducted on aluminum alloys under environmental conditions in metallurgical factories and in the atmosphere of an industrial city are presented. Corrosion losses in sheets of AMts-M, AMg6-M, and D16-T alloys were found to depend on the composition and character of the corrosive medium. Least corrosion losses were encountered in the metallurgical factory environment for the D16-T alloys with a protective plating of aluminum. Unplated D16-T alloy had the next best corrosion resistance followed

by AMts-M and AMg6. Corrosion in aluminum alloy building structures should be determined by losses in strength and depth of corrosion penetration rather than by weight losses. The advantage of aluminum alloys in corrosion resistance over steel in metallurgical factories is greater in open air conditions than inside buildings. Aluminum alloy structures gave long lasting corrosion protection in the range of corrosive media encountered in metallurgical factories. R.N.A.

N66-12740 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BASIS OF CERTAIN METHODS OF CALCULATION OF STRENGTH IN SN 113-60 [BUILDING STANDARDS]

B. M. Broude and G. M. Chuvikin *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 133–148 refs (See N66-12734 03-17)

Methods for determining the strength of aluminum alloys used in building materials are presented. Formulas are given for calculating the strength of eccentrically compressed aluminum alloy beams, with respect to the plane and bend-twist form of buckling, and of axially compressed beams. Methods are also formulated for calculating the over-all strength of aluminum alloy beams and the strength of web plates in beams. R.N.A.

N66-12741 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL INVESTIGATION OF LOCAL STRENGTH OF ANGULAR PROFILES FROM ALLOY D16-T

A. G. Immerman and V. S. Moskvitin *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 149–162 refs (See N66-12734 03-17)

The strengths of various angular profiles of aluminum alloy D16-T were investigated to determine the dependence of critical stresses of local strength on the flange width to thickness ratio, to determine the dependence between these ratios and beam flexibility i.e., to establish the connection between total and local strength to determine the influence of angular flange reinforcements with thickenings (beads) on the local strength of flanges, and to determine the optimum dimensions and form of the beads. Three series of experiments were conducted to establish optimum dimensions of angular samples. In the first series, equilateral angles without beads were tested. In the second, equilateral angles with beads were tested. In the third, unequilateral angles without beads, with one bead on a wide flange, and with beads on both flanges were tested. The materials used are described, and the methods and results of the experiments are discussed. R.N.A.

N66-12742 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL-THEORETICAL INVESTIGATIONS OF CENTRALLY-COMPRESSED RODS FROM ALUMINUM ALLOYS

A. Kh. Khokharin *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 163–182 refs (See N66-12734 03-17)

Tests were conducted on centrally compressed aluminum alloy rods to obtain an experimental appraisal of the degree of conformity of the actual load bearing ability of elements working under central compression, to compare this with the results of theoretical calculations, and to study the influence of rod cross section form on the character of their deformation under critical loads. Geometric characteristics of test samples and characteristics of the aluminum alloy D16-T from which they were made are tabulated. The tests were conducted on rods of round, tubular, tee, and corner profiles and the results are discussed. R.N.A.

N66-12743 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LOAD-BEARING ABILITY OF ECCENTRICALLY COMPRESSED RODS FROM ALUMINUM ALLOY AV-T1

B. G. Bazhanov *In its* Bldg. Struct. From Aluminum Alloys 27 Jul. 1965 p 183–211 refs (See N66-12734 03-17)

Experimental investigations were conducted on eccentrically compressed rods of the aluminum alloy AV-T1 with rectangular and H-shaped sections to determine their load bearing abilities. An approximation method of calculation, based on the acceptance of an idealized diagram with linear hardening, was used to obtain convenient calculating formulas for theoretically determining critical forces on eccentrically compressed aluminum alloy rods in the elastic–plastic stage. The theoretical results determined with the help of the approximation method agree well with experimental data obtained during tests on rods of the aluminum alloy AV-T1. R.N.A.

N66-12744 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NODAL JOINTS OF TUBULAR ALUMINUM TRUSSES

I. V. Levitanskiy *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 212–231 refs (See N66-12734 03-17)

Problems regarding the use of nodal joints in tubular aluminum alloy trusses are considered. The direct joining of tubular struts to tubular booms, plastic deformation of tubular sections, and strength characteristics of several welded tubular beams are examined. The main problem encountered in all the welds was the decreased strength of the nodal joints with respect to tubular strength. The basic causes of this lowering of strength were low quality seams, overstrain in direct joints, and irregularity of material in gusset joints. For light structures it was found impractical to complicate joints with flanges, paired gussets, and diaphragms. R.N.A.

N66-12745 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON VIBRATION STRENGTH OF RIVETED JOINTS FROM DURALUMIN AND ALUMINUM–MAGNESIUM ALLOY AMg61

N. I. Novozhilova *In its* Bldg. Struct. from Aluminum Alloys 29 Jul. 1965 p 232–245 refs (See N66-12734 03-17)

Fatigue tests were conducted on riveted joints from duralumin D1-T and aluminum–magnesium alloy AMg61 with rivets from alloys D18-T and V65-T to determine their vibration strengths. Test results show that duralumin D1-T possess a higher strength than duralumin D16-T. The fatigue limit of D1-T samples constitutes 14.36 kg/mm^2 without a concentration of stresses and on the basis of 2×10^6 cycles with a cycle characteristic of 0.073. The fatigue limit of D1-T riveted joint samples constitutes 8.7 kg/mm^2 on the basis of 2×10^6 cycles with a cycle characteristic of 0.071, or over 65% of the basic material strength. Vibration strength of the joint was determined by basic material strength and D18-T rivet strength. The vibration strength of aluminum–magnesium alloy AMg61 is near to that of duralumin D16-T. The fatigue limit of AMg61 samples constitutes 11.65 kg/mm^2 on the basis of 2×10^6 cycles with a cycle characteristic of 0.073 and without a concentration of stresses. The fatigue limit of AMg61 riveted joint samples with cold set rivets from alloy V65-T constitutes 6.6 kg/mm^2 on the basis of 2×10^6 cycles with a cycle characteristic of 0.036 or nearly 57% of the basic material strength. R.N.A.

N66-12746 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF WORK OF COMPOUND I-BEAMS FROM ALUMINUM ALLOYS

Yu. S. Mkrchants *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 247–276 refs (See N66-12734 03-17)

Results are presented of an investigation of real work of compound riveted beams from alloy D16-T and a welded I-beam from alloy AMg6 with web thicknesses of 4 to 6 mm under a static load. Also included are data on the local stability of webs, the distribution of stresses in beam elements, local and overall deformations, and the ultimate strength of the structures. R.N.A.

N66-12747 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ASSORTMENT OF GENERAL-USAGE PROFILES FROM ALUMINUM ALLOYS

A. G. Immerman *In its* Bldg. Struct. from Aluminum Alloys 27 Jul. 1965 p 277–292 refs (See N66-12734 03-17)

Data are presented on an assortment plan of general usage profiles for load bearing aluminum alloy structures. The basic concepts of a general assortment theory of metallic profiles are discussed which include equal sided and unequal sided angles with and without beads, I-beams and ordinary channels with flanges, strengthening beads, bead tees, tubings, and certain other profiles. R.N.A.

N66-12789# National Academy of Sciences–National Research Council, Washington, D. C. Prevention of Deterioration Center.

PROTECTIVE COATING SYSTEMS FOR NIOBIUM IN THE RANGE 1800–2500 F Bibliography

R. G. Lyle, comp. Jan. 1964 25 p refs *Its* PDC Search No. 64-001

(PDL-50205; AD-621546)

A bibliography giving pertinent references on 'Longtime high reliability coatings for 1800 to 2500 F columbium applications'. In addition to oxidation protection above 1800 F, information is given concerning ductility, flexibility, thickness, diffusional stability and resistance of coating systems to thermal shock and cycling, impact abrasion and vibration. TAB

N66-12810# United Aircraft Corp., East Hartford, Conn. Research Labs.

RESEARCH INVESTIGATION OF PHASE-REINFORCED HIGH TEMPERATURE ALLOYS PRODUCED DIRECTLY FROM THE MELT Final Report, 1 Jul. 1964–30 Jun. 1965

F. D. Lemkey, B. J. Bayles, and M. J. Salkind 31 Jul. 1965 96 p refs

(Contract DA-19-020-AMC-00434(X))

(UACRL-D910261-4; AMRA-CR-64-05/4; AD-622302)

An investigation has been performed to produce high temperature, high strength whisker, reinforced alloys directly from the melt. The technique of unidirectional solidification has been applied to the Ni3B–Ni, Ni–NiBe, Ti–TiB and Ta–Ta2C eutectic systems. These systems are summarized. TAB

N66-12840# Springfield Armory, Mass.

OCCLUSION OF VARIOUS REFRACTORY MATERIALS IN CHROMIUM PLATE ON STEEL SUBSTRATES

Francis X. Hassion and Joseph Szanto 16 Aug. 1965 42 p refs

(SA-TR18-1091; AD-621920)

Falex test pins plated at moderate current densities from standard chromium baths containing dispersoids of diamond dust, zirconia or thoria at volume concentrations of about 1 percent do not exhibit unusual wear characteristics. Falex test pins plated under similar conditions at high current densities show higher hardness and correspondingly improved wear resistance. The particle weights occluded in chromium plate deposited at high current densities amount to about 1 percent—an order of magnitude improvement over that achieved at conventional current densities and bath concentrations of dispersoid amounting to approximately 1 percent. Photomicrographs of both dispersed thoria and zirconia particles are included. Procedure is described and results are discussed. Author (TAB)

N66-12846# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

HIGH-TEMPERATURE CALORIMETRY OF THE IRON-VANADIUM ALLOY SYSTEM

Robert Lee Rapson (M.S. Thesis) Jun. 1965 58 p refs

(GME/ME/65-1; AD-622034)

High-temperature heat content data were obtained for the iron–vanadium alloy system by means of a diphenyl ether drop-type calorimeter. Data were compiled for pure iron, pure vanadium, and three representative alloys of iron and vanadium, over the temperature range from 600 to 1500 K. The results for the pure metals showed good agreement with published values. The alloy data followed smooth curves and exhibited behavior consistent with the thermal anomalies in the alloy system. Deviations from Kopp's Law, of the experimentally determined alloy heat capacities, showed a trend toward positive values with increasing temperature. The heats of formation for the alloys exhibited a change in sign from negative to positive at high temperatures. Author (TAB)

N66-12854*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.

DETERMINATION OF THE EFFECTS OF A THERMAL STERILIZATION PROCESS ON THE MECHANICAL AND ELECTRICAL PROPERTIES OF SOLDERED AND WELDED JOINTS Final Report

F. Z. Keister 9 Oct. 1965 246 p ref

(Contracts NAS7-100; JPL-951069)

(NASA-CR-68153; P-65-117) CFSTI: HC $6.00/MF $1.50 CSCL 11F

This investigation involved the preparation and testing of 1362 soldered joints of 11 different types, including both stranded and solid conductors joined to connector cups and bifurcated terminals. A total of 834 cross-wire weld joints of 7 different material combinations were also prepared and tested. All solder and weld joint types were tested and examined before and after thermal sterilization. Testing consisted of ultimate strength, electrical resistance, electrical testing during vibration, ultimate strength after vibration, stress–rupture strength, metallurgical examination, and electron probe microanalysis. Based on a statistical analysis of the test results, it was concluded that there was no significant change in the ultimate strength or electrical resistance of either the soldered or welded joints due to the effects of a thermal sterilization process. Neither the metallurgical examination nor the electron probe microanalysis showed any degradation in metallurgical structure or in the extent of gold diffusion. However, the stress–rupture strength tests on the connector cup soldered joints pointed out that steady state loads of only 10% of the ultimate strength of the joint were enough to cause short term solder joint failures under thermal sterilization conditions. Author

N66-12873*# Tennessee Univ., Knoxville. Dept. of Chemical and Metallurgical Engineering.
THE APPLICATION OF DIFFUSE X-RAY-SCATTERING TO THE STUDY OF THE STRUCTURE OF BINARY ALLOYS Semiannual Progress Report, 1 Mar.–31 Aug. 1965
J. E. Spruiell [1965] 9 p refs
(Grant NGR-43-001-018)
(NASA-CR-68233) CFSTI: HC $1.00/MF $0.50 CSCL 20B

Research is reported in an experimental and theoretical investigation of the relationship between the local atomic arrangements in metallic solid solutions, and the physical and mechanical properties of the solid solutions. Emphasis was placed on the growth of satisfactory alloy single crystal specimens for X-ray diffuse scattering experiments, and the development of an experimental apparatus for both X-ray and resistivity measurements. It is also reported that some measurements were performed on Ni-10 at. % W and Ni-20 at. % Mo alloys. C.T.C.

N66-12875*# Union Carbide Corp., Parma, Ohio. Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS Progress Report No. 3, 1 May–31 Jul. 1965
J. M. Criscione, J. Rexer, and R. G. Fenish [1965] 22 p ref
(Contract NASw-1030)
(NASA-CR-68181) CFSTI: HC $1.00/MF $0.50 CSCL 11C

The rate of interdiffusion of iridium and tantalum was determined as a function of temperature in the range 1200° to 1600° C. An apparent activation energy of 53.5 kcal/mole was obtained for the overall diffusion process. Iridium-coated tantalum specimens were subjected to oxidation tests in slow moving air at 1850° C. Pressure bonded and electrodeposited coatings of iridium on tantalum were subjected to oxidation tests in slow moving air and in an oxygen-methane flame. A 5-mil iridium coat completely protected tantalum from oxidation for 51 hours at 1850° C in slow moving air. The recession rate of the coating was 0.02 mils/hr. No internal oxidation was observed. A 5-mil iridium coat on tantalum was also cycled four times without failure through various temperature spans in the range 25° to 1700° C in an oxygen-methane flame. Preliminary oxidation tests in slow moving air and in an oxygen-methane flame showed early failure for electrodeposited iridium coats on molybdenum, tantalum, and tungsten. Premature failure was due to poor adherence of the coating. Author

N66-12901# Los Alamos Scientific Lab., N. Mex.
HYDROGEN EMBRITTLEMENT TESTS OF CRYOGENIC METALS
R. L. Mills and F. J. Edeskuty 29 Nov. 1965 10 p refs
(Contract W-7405-ENG-36)
(LA-3404-MS) CFSTI: $1.00

Specimens of six aluminum alloys, 1100, 2024, 5052, 6061, 7039, 7079; Invar-36; titanium-6Al-4V; and mild carbon steel AISI-C1019 were exposed to cathodic hydrogen for 30 min at a current density of 1 amp/sq in. Immediately following exposure, the samples were bent through successive 180-deg bends until broken. Except for AISI-C1019, which was known to embrittle, none of the materials was measurably affected by the exposure. Other specimens of Invar-36 which were exposed to gaseous hydrogen at 1700 lb/sq in. and ambient temperature for 24 hr likewise showed no hydrogen embrittlement. Author

N66-12913# Hanford Atomic Products Operation, Richland, Wash. Chemical Processing Dept.
INVESTIGATION OF CD_4M Cu AS A HANFORD MALE CONNECTOR (NOZZLE) MATERIAL
Paul S. Kingsley 15 Jul. 1965 11 p
(Contract AT(45-1)-1350)
(RL-SEP-508)

It has been demonstrated that a casting of stainless steel (ACI# CD_4M Cu) has adequate strength and corrosion resistance when properly heat treated to become a capable substitute for the stellite-faced 304-L male connector (nozzle) employed at Hanford for a number of years. Author

N66-12932# Battelle-Northwest, Richland, Wash.
CORROSION EVALUATION OF HIGH-SILICON ALUMINUM ALLOYS
H. C. Bowen Sep. 1965 23 p ref
(Contract AT(45-1)-1830)
(BNWL-125) CFSTI: $1.00

A battery of tests was performed on four high-silicon aluminum alloys containing nickel and/or magnesium. The tests included high and low flow isothermal and nonisothermal 140° C water tests, galvanic couples, stress corrosion cracking tests, and tests in 400° C steam and 360° C water. The HDA-1 and -4 alloys were decidedly superior to the other two alloys in the nonisothermal high flow, the 360° C water, and the 400° C steam tests which are considered the tests of most significance. The HDA-4 alloy had better resistance in high temperature water and is considered the most promising alloy. Author

N66-12934# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
SPARK PLANING DAMAGE IN COPPER
John J. Gniewek, Alan F. Clark, and John C. Moulder 6 Sep. 1965 10 p refs
(NBS-TN-321) GPO: $0.15

The damage to copper crystals, produced by spark planing operations, has been measured using a dislocation etch pit technique. The tabulated results show the depth of damage to vary from 0.7 to 1.1 mm on the coarsest planing range used, to 0.2 to 0.3 mm on the finest range. Two photomicrographs showing the etch pit density increase near the spark planed surface are included. Author

N66-12935# Battelle-Northwest, Richland, Wash.
METALLURGY RESEARCH OPERATION Quarterly Progress Report, Apr.–Jun. 1965
15 Jul. 1965 129 p refs
(Contract AT(45-1)-1830)
(BNWL-120) CFSTI: $4.00

Research progress is reported on the effects of impurities and neutron irradiation on properties and structure of molybdenum, nickel, and rhenium; properties of high purity unalloyed and alloyed plutonium; damage to mechanical properties of irradiated iron caused by interaction of moving dislocations with irradiation induced defects; swelling of irradiated fissionable materials; irradiation and environmental effects on nickel-base alloys; in-reactor creep and rupture properties of annealed 304 SS; irradiating, testing, and data processing for different structural materials; irradiation and reactor environment effects on stainless steels; effect of modified microstructures on irradiation stability of nickel-base alloys; fracture studies; corrosion and materials testing studies with Advanced Test Reactor loop; N-reactor corrosion and hydriding; gas loop development; Plutonium Recycle Test Reactor pressure tubes; and Zr–Nb pressure tubing. R.N.A.

N66-12940# Pratt and Whitney Aircraft, Middletown, Conn.
MODIFIED TIN–ALUMINUM SLURRY COATINGS FOR MULTI-THOUSAND HOUR APPLICATIONS

L. A. Friedrich, E. C. Hirakis, and N. S. Bornstein 14 Oct. 1965 42 p refs
(Contract AT(30-1)-2789)
(TIM-945)

Two slurry applied coating compositions, designated PWK-1 and PWK-35, were developed for the protection of refractory metals. Chromium and titanium additions to the basic tin–aluminum coating composition improved protection in air above 650° C. Mean lifetimes, derived from a statistical analysis of oxidation data for the PWK-35 coated Cb-1 Zr alloy and four Cb-Ti alloys, approximated 10000 hours in 650° C air and ranged from 1500 hours for coated Cb-1 Zr alloy to 3500 hours for the coated Cb-Ti alloys in 871° C air. Procedures for applying the coating to engineering structures were developed. Encouraging results were obtained in tests to evaluate protection in impure helium environments for periods to 5000 hours at temperatures to 1093° C. Author

N66-12944# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
MECHANICAL BEHAVIOR OF DILUTE ALLOYS OF NIOBIUM Final Report
G. M. Sinclair 27 Jul. 1965 8 p refs
(Contract AT(11-1)-1046)
(TID-22117)

A summary of final research on the mechanical behavior of dilute niobium alloys is presented. It was found that the fatigue strength and yield strength of niobium were insensitive to changes in metallurgical grain size. The large solid solubility of niobium for interstitial impurities resulted in large strength maxima in fatigue and tension loading at critical temperatures which depend on the applied strain rate and diffusion constants of the impurity. The implication was that Nb, Ta, and V should have large strength maxima and similar effects would be small in Cr, Mo, and W which have lower solid solubilities for interstitials. Available data on Ta and Mo support this contention. It is believed that the rules governing pressure temperature composition relations for interstitials in pure niobium are now well established. However, information is sketchy as to how these relations are affected by alloying additions such as Zr. More recent results on the low temperature yield behavior of polycrystalline and single crystal niobium imply that given the results of a few simple tension tests for a specific material, it is possible to predict yield strength over a wide range of states of stress, temperatures, strain or stress rates, different compositions, and metallurgical structures. R.N.A.

N66-13033# Atomic Weapons Research Establishment, Aldermaston (England).
THE FATIGUE OF URANIUM
P. D. Tilbury Aug. 1965 19 p refs
(AWRE-O-65/65) CFSTI: HC $1.00/MF $0.50

Tests were carried out on a push-pull machine at zero mean stress and gave for the fatigue limit of worked and annealed uranium 30000 psi at 10^2 cycles of alternating stress, which is the tensile strength × 0.39. Cold working and decreasing the temperature raise the fatigue limit, hydrogen atmospheres have little effect, but the notch effect of a crack in protective plating can lower the fatigue limit seriously. Author

N66-13038# Nuclear Metals, Inc., Concord, Mass.
FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY Progress Report, 1-31 Mar. 1965
20 May 1965 29 p ref
(Contract AT(30-1)-2784)
(NYO-2784-9; NMI-2138)

Effort continued on establishing fabrication steps for tungsten-25 w/o rhenium tubing of two sizes: 1/4-inch OD × 20-mil wall and 80-mil OD × 8-mil wall. For the larger size, promising results were obtained in moving-mandrel drawing, followed by reeling. The reeling operation is being performed successfully through the use of appropriate hard mandrels at proper working temperatures. For the smaller size, conditions for consistently satisfactory re-extrusion are still being sought. Inconclusive results were obtained in a series of tandem extrusions in which the histories of a W-25 Re stock and an inner molybdenum filler, extrusion temperature, and reduction ratio were investigated. Investigations on the fundamentals of single crystal deformation in zone refined beryllium were conducted on the effects of interstitials and combination alloying additions. R.N.A.

N66-13042# Commissariat A l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ELECTRON MICROSCOPE OBSERVATION OF SINGLE-CRYSTALLINE BERYLLIUM THIN FOILS [OBSERVATION DE LAMES MINCES MONOCRISTALLINES DE BERYLLIUM EN MICROSCOPIE ELECTRONIQUE]
Jacqueline Antolin, Jean-Paul Poirier, and Jean-Michel Dupouy May 1965 50 p refs In FRENCH
(CEA-R-2789) CFSTI: HC $2.00/MF $0.50

The characteristics and mechanisms of various states of plastic deformations in beryllium single crystal thin foils are investigated. A study is made of the types and configurations of dislocations which characterize the various states. Both plane and prismatic slippage are offered as possible mechanisms for these dislocations. Finally, dislocations produced by tempering are considered, and their characteristics and mechanisms are discussed. Transl. by D.T.

N66-13072# Denver Research Inst., Colo.
STUDIES OF THE EFFECT OF INTERSTITIAL ADDITION ON THE PHASE EQUILIBRIA OF THE NIOBIUM-RICH REGION OF THE NIOBIUM-TUNGSTEN-HAFNIUM AND NIOBIUM-TUNGSTEN-ZIRCONIUM ALLOY SYSTEMS Quarterly Progress Report No. 3, 1 Mar.–31 May 1965
Albert S. Yamamoto Jun. 1965 12 p refs
(Contract AT(11-1)-1092)
(DRI-1092-211)

Progress in the investigation of the effect of C additions on the phase relationships of the Nb-rich region of the Nb–W–HF and N–W-Zr alloy systems is reported. Isothermal annealing at 1600 and 1300° C of the Nb–W–Hf with nominal C additions of 0.5, 0.25, 0.1, 0.05 and 0.01 wt % were completed. Microscopic examination of the annealed alloy structure showed a second phase or phases present in all the alloys investigated at both temperatures except a Nb–0.5 W–0.5 Hf–0.01C, which showed nearly a single-phase structure at 1600° C. A limited number of the Nb–W–Zr alloys containing nominal 0.25, 0.1, 0.05, and 0.01 wt % were heat treated isothermally at both 1600 and 1300° C. All the annealed and quenched alloys examined metallographically exhibit the structures with precipitates, varying in the amounts and mode of precipitation. X-ray diffraction studies of the carbon-bearing alloys in the two systems are in progress. Author (NSA)

N66-13102# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
PRECIPITATION OF HYDRIDES IN ZIRCALOY-2 AS AFFECTED BY PREFERRED ORIENTATION, ELASTIC STRESS, AND HYDROGEN CONTENT

P. L. Rittenhouse and M. L. Picklesimer Sep. 1965 21 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1239)

Hydride plates in Zircaloy-2 that are oriented perpendicular to a stress direction can drastically reduce ductility. This report discusses a continuation of work to determine the factors that influence directional precipitation of the hydride. Zircaloy-2 specimens were hydrided to three hydrogen levels and the hydrides were precipitated while the specimens were subjected to an elastic stress in either the rolling or transverse direction. Stresses applied during precipitation cause a reorientation of the hydrides which is dependent on stress level, the direction of stress relative to crystallographic features of the texture of Zircaloy-2, and hydrogen content. Author

N66-13107# Institut de Soudure, Paris (France).
STUDY OF WELDED JOINTS FOR VERY THICK STEEL PLATES Quarterly Report No. 3, 1 Jan.–31 Mar. 1965
23 Jun. 1965 14 p Transl. into ENGLISH from French
(Contract EURATOM-007-64-TEEF(RD))
(EURAEC-1362) CFSTI: HC $1.00/MF $0.50

A brief discussion is given of single J bevelling with an oxyacetylene torch. The heat cycle connected with the operation is considered along with a metallographic study of the process. Elementary cracking and hardness tests in the heat-affected zone are also considered. C.T.C.

N66-13109# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
STUDY OF $\gamma \rightarrow \beta$ AND $\gamma \rightarrow \alpha$ TRANSFORMATIONS IN URANIUM-MOLYBDENUM ALLOYS OF LOW-MOLYBDENUM CONTENT [ETUDES DES TRANSFORMATION $\gamma \rightarrow \beta$ ET $\gamma \rightarrow \alpha$ DANS LES ALLIAGES URANIUM-MOLYBDENE DE FAIBLES TENEURS]
Jacqueline Lefranc May 1965 60 p refs In FRENCH
(CEA-R-2763) CFSTI: HC $2.00/MF $0.50

The distance between the curves at the beginning and at the end of the $\gamma \rightarrow \beta$ transformation gets progressively smaller as the transformation temperature increases. A delay in the transformation was observed when the alloys have undergone a homogenizing treatment (950° C) which leads to a large-grain γ structure. Author (NSA)

N66-13112# MSA Research Corp., Callery, Pa.
STRAIN-ENHANCED DIFFUSION OF CARBON IN STAINLESS STEEL Literature Survey
R. Hiltz and F. Tepper 29 Jun. 1965 7 p refs
(Contract AT(11-1)-765)
(MSAR-65-89)

A literature survey was conducted on the effect of strain on diffusion of alloy or impurity elements in a metal matrix. An explanation for the observed effect of strain-enhanced carburization of stainless steel is proposed. NSA

N66-13117# Los Alamos Scientific Lab., N. Mex.
MAGNETIC SUSCEPTIBILITY OF DELTA PLUTONIUM-ALLOYS
J. L. Lunsford and E. A. Kmetko 1965 12 p refs Presented at the Conf. of the Royal Commonwealth Soc., London, 22–26 Nov. 1965
(Contract W-7405-ENG-36)
(LA-DC-7360)

The magnetic susceptibilities χ of two series of delta-phase alloys made of high purity plutonium and aluminum or gallium were measured from 6° K to room temperature. The dependence of χ upon both solute concentration and temperature are weakly negative, the behavior being monotonic in both cases. On the assumption that χ consists only of a Pauli spin paramagnetic term and a diamagnetic term associated with the radon-like core, the density of states at the Fermi level, at 0° K, is very nearly 20 states/atom-eV. The results are discussed in terms of a two-band model for the electronic structure of delta plutonium. C.T.C.

N66-13148# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
THE PREPARATION AND PROPERTIES OF SINTERED Nb_3Sn
C. H. Walker and R. Hancox May 1965 14 p refs
(CLM-R-43) CFSTI: HC $1.00/MF $0.50

Sintered Nb_3Sn has been formed, which is capable of supporting current densities greater than 10^5 amps/cm^2 at 50 kG, and is stable against field changes of at least 55 kG. The factors which affect stability are discussed, including the importance of the structure of the sintered material. Author

N66-13190# Ghent Univ. (Belgium).
THE WELDING OF VERY THICK STEELS. MARGIN OF UNCERTAINTY OF THE ROBERTSON TEST
20 May 1965 15 p refs *Its* Special Rept. No. 7
(Contract EURATOM-042-61-9-RDB)
(EURAEC-1406; EUR-2365) CFSTI: HC $1.00/MF $0.50

Tests were performed to determine the uncertainty zone of the Robertson test. A temperature zone in which the result is governed by an uncertain probability was observed. By applying the maximum probability method it is possible to evaluate the extent of this zone for the case in question, but this evaluation is very indeterminate. In addition, the conclusions drawn from the tests described are only valid a priori for the type of steel tested. It is concluded from these tests that the brittle fracture criteria based on the large-scale tests are affected by an uncertainty zone that cannot be neglected. The comparison of test results is in danger in many cases of producing conclusions which could be unfounded and be the result of fortunate or unfortunate chance during the tests. Author (TAB)

N66-13213# New York Univ., N. Y. Research Div.
DEVELOPMENT OF TOUGH, HIGH STRENGTH ALPHA BETA TITANIUM-BASE ALLOYS AT 240,000–260,000 PSI YIELD STRENGTH LEVEL Quarterly Progress Report, No. 9, 26 Jun.–25 Sep. 1964
P. A. Farrar and H. Margolin [1965] 40 p refs
(Contract DA-30-069-ORD-3690)
(WAL-TR-401/303-8; AD-470843)

In order to develop titanium alloys with higher ductilities and 0.1% yield strengths in the range of 190,000 to 240,000 psi and usable ductility in the range from 240,000 to 260,000 psi, 30 eight pound ingots were investigated and an additional 26 eight pound ingots are now being evaluated as part of Phase II. The data on 9 ingots from this second group is included in this report. Four alloys which showed promising properties in the 190,000–240,000 psi range as 8 lb ingots were remelted as 80 lb ingots for further evaluation as bar, plate and sheet material. Tensile tests at room temperature and −40 F impact tests have been completed on the bar stock and the plate for the four ingots. Welding experiments have been completed on the sheet and the data included herein. Author (TAB)

N66-13231*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE-CRACK PROPAGATION AND RESIDUAL STATIC STRENGTH OF PH 15-7 Mo (TH 1050) STAINLESS STEEL
C. MichaesHudson (M.S. Thesis—Va. Polytech. Inst.) Washington, NASA, Dec. 1965 33 p refs
(NASA-TN-D-3151) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Fatigue-crack propagation and residual static-strength data from tests on 2-inch wide sheet specimens made of stainless steel are presented in this report. In addition, the capabilities of McEvily and Illg's crack-growth analysis and Kuhn and Figge's residual strength analysis to correlate the test data have been investigated. Kuhn and Figge's equation for calculating the stress concentration factors for cracks was used in both analyses. Analysis of the data showed that the crack growth and residual strength analyses satisfactorily correlated the majority of the test data. Author

N66-13244# Oak Ridge National Lab., Tenn.
TRACER DIFFUSION IN METALS. PART II: IMPURITY DIFFUSION IN PURE METALS A Bibliography, 1938–Dec. 1964
John Askill, comp. Nov. 1965 24 p refs
(Contract W-7405-ENG-26)
(ORNL-3795, Pt. II)

Frequency factors and activation energies for tracer solute diffusion in pure metals have been compiled from the literature reported between 1938 and December 1964. An authors' index is also included. Author

N66-13247# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
EVALUATION OF SAPPHIRE WOOL AND ITS INCORPORATION INTO COMPOSITES OF HIGH STRENGTH Technical Report, May 1964–May 1965
R. L. Mehan, Earl Feingold, and A. Gatti Aug. 1965 88 p refs
(Contract AF 33(615)-1696)
(R65SD36; AD-468533)

This program is concerned with the mechanical characterization of α-Al_2O_3 wool whiskers in the effective diameter range of about 0.6 to 4.0 microns and with feasibility studies directed toward the incorporation of the wool into an aluminum matrix. It is concluded, based on approximately 100 tensile tests and past experimental work, that sapphire wool in this size range has a strength of about 1.6 million psi and or plus 80% for gage lengths greater than 0.1 mm. Based on the present results, the elastic modulus seems to be the same as for the single crystal sapphire (60-70 million psi). Studies of crystalline perfection by electron microscopy revealed that the surface of sapphire wool is not structurally perfect, but contains defects along the length. Feasibility studies of composite fabrication indicated that sapphire wool could be incorporated into an aluminum matrix by either infiltration or hot-pressing techniques. Because of limited time, only low volume fractions were attained, and hence no mechanical strengthening was observed. It was concluded that sapphire wool is a promising reinforcing material for the fabrication of metallic composites. Author (TAB)

N66-13284* National Aeronautics and Space Administration, Washington, D. C.
ALLOYS OF PALLADIUM WITH TUNGSTEN, RHENIUM, OSMIUM AND IRIDIUM
Ye. M. Savitskiy, M. A. Tylkina, V. P. Polyakova, I. A. Tsyganova, and Ch. V. Kopetskiy *In its* Elec. Contacts Dec. 1965 p 348–357 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The physical and chemical interactions of palladium with the transitional metals of the III long period (tungsten, rhenium, osmium, and iridium) were considered. With all these metals, palladium forms structural diagrams of the peritectic type with two restricted solid solutions. Chemical compounds were not detected in the systems. The effect of alloying palladium with tungsten, rhenium, osmium, and iridium on its properties—hardness, ultimate strength, relative elongation during tension, recrystallization, specific electric resistance and its temperature coefficient, and the absolute thermo-emf when paired with copper—was also considered. Author

N66-13285* National Aeronautics and Space Administration, Washington, D. C.
STABILITY OF ELASTIC ELEMENTS OF COMMUNICATIONS EQUIPMENT AT ELEVATED TEMPERATURES
R. I. Mishkevich *In its* Elec. Contacts Dec. 1965 p 358–374 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

To meet the requirements imposed on current-carrying springs designed for communications equipment, several experiments were conducted on alloys with a copper base, a nickel base, and a molybdenum base. Investigations of relaxation at elevated temperatures were carried out using copper base alloys in both the deformed and the heat-treated states. The effect of temperature and soaking, during low temperature annealing, on the elastic properties of the alloys were determined at room temperature, and the effects of temperature on relaxation stability were investigated at elevated temperatures. Optimum low temperature annealing states were established from these data. Because of the trend toward miniaturization, small cross sections were used in testing. Details are given on the stress relaxation of the 18 spring materials studied, and results indicate that low temperature annealing increases the limits of elasticity and retards the relaxation processes. M.G.J.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-12448# Goodyear Aerospace Corp., Litchfield Park, Ariz.
A STUDY TO DETERMINE THE OPTIMUM URETHANE FOAM COATING FOR PROTECTING ICE AND SNOW SURFACES Final Report, Jan.–Jul. 1965
Port Hueneme, Calif., Naval Civil Eng. Lab., Jul. 1965 135 p refs
(Contract NBy-62161)
(GERA-979; AD-469935)

Previous research was conducted to determine if urethane foam would protect ice and snow surfaces from deterioration when subjected to summer season temperatures and solar radiation in the polar regions. The work proved the ability of urethane foam to provide thaw protection but disclosed two problem areas. These areas were trafficability and wind resistance. This report deals with these two areas as well as with transportation storage, foam generation, application, and maintenance associated with the task of providing a protective foam cover for ice and snow surfaces. The investigation of protective covers resulted in two final concepts which provide adequate resistance to traffic and wind are worthy of full scale

development. The two concepts are the regenerating foam-granule/snow cover technique, utilizing a layer of insulating granules covered by a flexible fiberglass laminate cover. Standard procedures for polar operations may be followed. Most of the equipment required for preparing and maintaining these protective covers is that normally used on polar runways. No major problems were found in the areas of transportation, storage, generation and application of the protective foam. Author (TAB)

N66-12482# Battelle Memorial Inst., Columbus, Ohio.
HOT ISOSTATIC COMPACTION OF GRAPHITE
Donald C. Carmichael, P. Darrell Ownby, and Edwin S. Hodge 5 Oct. 1965 38 p refs
(Contract W-7405-ENG-92)
(BMI-1746) CFSTI: $1.00

The effects of temperature, pressures and graphite starting material on the density, isotropy, and strength of dense graphite material prepared by hot isostatic compaction of graphite powders were examined. Process equipment was developed to permit operation at temperatures up to 2700° C under a 1600-atom isostatic pressure of inert gas. The isotropy of graphite compacts was determined by neutron diffraction. Relatively isotropic, high-purity graphites were produced having modest isotropic tensile strength and extremely high density (up to 2.24 g per cm^3, or 99 percent of theoretical) Author

N66-12552# California Univ., Berkeley.
DYNAMIC BEHAVIOR OF CONCRETE, 4 MARCH 1964–15 SEPTEMBER 1965
Werner Goldsmith, Milos Polivka, and Ta-Lun Yang China Lake, Calif., Naval Ordnance Test Sta., Oct. 1965 44 p refs
(Contract N60530-9806)
(NAVWEPS-8790; NOTS-TP-3890; AD-620930)

Concrete and cement paste specimens, representing a model of the actual structural material and of its adhesive component, respectively, were subjected to static and dynamic tests. Static tests on virgin specimens were carried out in order to evaluate the strength, elasticity and Poisson's ratio of the materials. The dynamic experiments were conducted in order to ascertain the response of the specimens to the propagation of one-dimensional pulse. Transient loading was accomplished by the central longitudinal impact of a 1/2-in diameter steel sphere on a ballistically suspended 3/4-in diameter Hopkinson bar of the material at an initial velocity of about 3260 in/sec or 1650 in/sec. The shocked specimens were also subsequently examined to determine whether changes in static material properties had occurred as a result of passage of the waves. Both static and dynamic tests yielded consistent results for a number of specimens cast and cured in identical fashion. Comparison of the properties of the virgin and the shocked specimens indicated little, if any shock damage. While some minor grain damage was observed in microscopic examination of thin sections taken from some of the shocked specimens, other sections did not indicate any visible cracking of the grains. The wave propagation process appeared to occur without dispersion and relatively little attenuation, indicating that the material could be represented on a macroscopic scale as an 'elastic' substance with a small structural damping coefficient. The obvious inhomogenieties of the concrete affected the gage response whenever a gage was mounted directly over a piece of aggregate. Author (TAB)

N66-12562# American Cyanamid Co., Stamford, Conn.
THE RELATIONSHIPS BETWEEN POLYMERS AND GLASS TRANSITION TEMPERATURES Technical Report, Jun. 1963–May 1965
O. G. Lewis and L. V. Gallacher Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1965 84 p refs
(Contract AF 33(657)-11224)
(AFML-TR-65-231; AD-620734)

A study of some empirical and theoretical functions for the effect of temperature on liquid viscosity indicated that the viscosities of the n-alkanes are well represented by the equation log (eta/d) = log (A/T) + B/(T-T_0), where d is the density and A, B and T_0 are smooth functions of chain length. The effect of increasing static pressure is to increase A and T_0, while B is the only slightly affected. A diagrammatic method for evaluating steric effects in polymer chains was developed. Some excluded volume effects in rings and short chains of the-CX2- type are elucidated in this way. An empirical approach to estimation of flex energy and hence T_0 is suggested. A statistical-mechanical theory of the glass transition was developed, based on the concept that the observable communal entropy is time dependent. The activation free energy, enthalpy and entropy at the glass temperature were evaluated for several polymers. Intermolecular interactions in liquid alkanes were studied, and an additive property Q = (BpV)0.7240 was found, where Bp is the Antoine vapor pressure constant, and V the molar volume. Q is dependent on the number of C atoms, the number of side branches, and the number of pairs of vicinal branches. TAB

N66-12845# David Taylor Model Basin, Washington, D. C.
HYDROSTATIC, CREEP, AND CYCLIC TESTS OF RADIALLY ORIENTED GLASS-FIBER REINFORCED PLASTIC SPHERES
William P. Couch Sep. 1965 15 p refs
(DTMB-2089; AD-622071)

A technique was developed in which glass-reinforced plastic spheres can be fabricated with the fibers oriented in the radial direction. The David Taylor Model Basin tested two 3-in.-diameter spheres of such construction and obtained very encouraging results. The two spheres tested had a weight to displacement ratio of 0.50 and a collapse pressure of a least 25,000 psi. A maximum stress of 165,000 was developed in the spheres prior to failure. Failure most likely occurred by elastic buckling. A 5-hr creep test conducted at a pressure comparable to a depth of 20,000 ft which generated a stress level of 57,500 psi indicated that creep was not severe. A cyclic test of 5000 times to a depth of 20,000 ft resulted in no apparent reduction in structural integrity. Author (TAB)

N66-12985*# Mellon Inst., Pittsburgh, Pa.
VISCOELASTIC BEHAVIOR OF POLYMERS AT LONG TIMES Ninth Semiannual Report for Period Ending 31 Oct. 1965
Donald J. Plazek [1965] 3 p
(Grant NsG-147)
(NASA-CR-68372) CFSTI: HC $1.00/MF $0.50 CSCL 11J

Studies of natural rubber vulcanizates with different crosslink densities were extended to the temperature range 1° to −50° C through utilization of a magnetic suspension torsional creep apparatus. Results established the region of rubbery response in the primary softening transition. The sum total of all density studies were used to produce a compliance curve that is probably applicable to all crosslinked elastomers. Measurements were continued on the polyvinyl acetate, PVAc, and polymethylmethacrylate, PMMA. A paper on the crystallization kinetics of 1,3,5-tri-α-naphthyl benzene has been written. G.G.

N66-13088*# Melpar, Inc., Falls Church, Va. Research Div.
INVESTIGATION OF THE EFFECTS OF MECHANICAL STRESS ON THE PERMEABILITY OF ENGINEERING MATERIALS TO CERTAIN CRYOGENIC AND STORABLE PROPELLANTS USED IN LAUNCH VEHICLES Annual Summary Report, 30 Jun. 1964–30 Jun. 1965
P. J. Lare, W. R. De Boskey, A. Divecha, and H. Hahn Sep. 1965 143 p refs
(Contract NAS8-11322)
(NASA-CR-68411) CFSTI: HC $4.00/MF $1.00 CSCL 11I

Apparatus and methods now in use are considered suitable for measuring permeability rates through highly stressed materials in the range 10^{-10} to 10^{-17} SPU. The chemical compatibility of Mylar, aluminized Mylar, aluminized Tedlar, nylon based adhesive, polyurethane foam, silicon rubber, and polyvinyl chloride with monomethylhydrazine was inadequate for uses involving prolonged exposure in terms of dissolution, fluid discoloration, and/or degradation of mechanical properties. Polymeric materials compatible with monomethylhydrazine include Teflon, Tedlar, and polyethylene. The mechanical properties of metallic and polymeric materials at room and cryogenic temperatures were evaluated. Coarse permeability screening tests were suitable in identifying such limiting parameters as specimen dimensions and material imperfections. Probable permeation of hydrogen through 0.008 inch stainless steel at liquid hydrogen temperature was observed. The permeability of nitrogen tetroxide and gaseous nitrogen through Teflon was observed at 1 to 4×10^{-14} and 1.3 to 1.7×10^{-10} SPU respectively. Neither value was affected by stress level. Permeation rates for FEP Teflon were higher than those for TFE Teflon. R.N.A.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-12280# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE LAME EQUATION
N. I. Akhiezer [1965] 12 p refs Transl. into ENGLISH from Zap. Mekh.-Matem. Fak., (Khar'kov), v. 30, ser. 4, 1964 p 5–17

A detailed exposition and some generalizations are presented on one of the results obtained from a continual analog of orthogonal polynomials on a system of intervals. Equations are given for the inverse Sturm–Liouville problem on a semiaxis for the case when the spectral function is absolutely continuous and its derivative is defined by certain equalities. M.G.J.

N66-12283# Stanford Research Inst., Menlo Park, Calif.
ALGEBRAIC THEORY OF SEMI-AUTOMATA CASCADES Scientific Report No. 2
Michael Yoeli 1 Aug. 1965 18 p refs
(Contract AF 19(628)-5092)
(AFCRL-65-583; AD-621750)

Cascade products of partially specified semi-automata (i.e., output-free automata) are defined and necessary and sufficient conditions are obtained for a semi-automaton to have a non-trivial representation as a homomorphic image of a subsystem of some cascade product of (simpler) semiautomata. The basic algebraic concepts of homomorphic relation and admissible covering play an important role in these investigations. Author (TAB)

N66-12287# Michigan Univ., Ann Arbor. Information Systems Lab.
A STUDY OF A MODEL FOR PARALLEL COMPUTATION
Raymond Reiter Jul. 1965 36 p ref *Its* Rept.-06920-4-T
(Contract AF 30(602)-3546)
(ISL-65-4; AD-621978)

A generalization is given of a model for parallel computation as formulated by Karp and Miller (R. M. Karp and R. E. Miller, Properties of a model for parallel computations: determinacy termination, queueing, IBM Research Paper RC-1285). A parallel computation is viewed as a directed graph in which a node represents a sequence of operations to be performed upon data on the node input branches with the results of an operation being placed upon the output branches. An operation associated with a node n may initiate if and only if, for each input branch d to n, the data queue length on d is grater than, or equal to, some threshold T. It is shown that a unique computation is defined independently of the timing of the node operations. Methods are derived for determining whether a computation terminates and for finding the number of performances of each node computation step involved. In particular, an algorithm is given which yields the number of performances of each node computation step for the set of termininating nodes of a computation graph. Necessary and sufficient conditions for data queue lengths to remain bounded are derived. Author (TAB)

N66-12301# Computer Usage Co., Inc., Palo Alto, Calif.
STRATEGIES OF FUNCTION DECOMPOSITION FOR ARTIFICIAL INTELLIGENCE. VOLUME II: RESEARCH NOTES 12–25, SEP. 1964–JUN. 1965
David G. Willis 1 Jul. 1965 153 p refs
(Contracts AF 49(638)-1315; AF 49(638)-1454)
(AFOSR-65-1612; AD-620186)

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2. THE INFORMATION STRUCTURE OF DISCRETE FUNCTIONS. RESEARCH NOTE 13 20 p refs (See N66-12303 03-19)

3. VACUOUS VARIABLES OF PARTIAL FUNCTIONS. RESEARCH NOTE 14 15 p refs (See N66-12304 03-19)

4. VARIABLES IN SUBSETS A AND B. RESEARCH NOTE 15 20 p (See N66-12305 03-19)

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13. COST MEASURES AND DECOMPOSITIONS OF CONTINUOUS VARIABLES AND FUNCTIONS. RESEARCH NOTE 24 8 p (See N66-12314 03-19)

14. REVIEW AND DISCUSSION OF NOTES 1–24. RESEARCH NOTE 25 11 p (See N66-12315 03-19)

N66-12302 Computer Usage Co., Inc., Palo Alto, Calif.
SUMMARY OF CERTAIN RESULTS ON CONTINUOUS FUNCTIONS, DECOMPOSITION CLASSIFICATION, COSTS, AND GENERALIZATION Research Note 12
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 11 p (See N66-12301 03-19)

Considered were the following: (1) *Simple Decompositions in Continuous Functions*—it is shown that continuous, single-valued functions of continuous single-valued variables may possess decomposition structures analogous to those of discrete functions if the partial derivative is everywhere zero; (2) *Elementary and Composite Decomposition*—every subfunction of an elementary decomposition corresponds to a subfunction of a simple decomposition, and theorems for composite decompositions determine which subsets of variables may be contained in the problem corresponding to frontal switching functions; (3) *Lower Bound on the Number of Different Functions which Have Decompositions of Cost C or Less*—it can be shown that the number of p-valued variables with a decomposition of cost c or less for a number of $\mu(c)$ different k -or-less valued functions of n is $\mu(c) \geq \rho^{nc}$; and (4) *Generalization Properties of Decompositions*—black box functions for problems of switching functions having a single non-overlapping decomposition. G.G.

N66-12303 Computer Usage Co., Inc., Palo Alto, Calif.
THE INFORMATION STRUCTURE OF DISCRETE FUNCTIONS Research Note 13
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 20 p refs (See N66-12301 03-19)

Considered was a set of variables having m different configurations where the n,p-valued variables are expressed by $m = p^n$. Both total and partial functions of these variables were calculated for m or less differential functional values by separating the set of functions into disjoint equivalence classes. Membership in the classes was invariant under permutation of the function values. Since all of the possible structures represent all of the possible ways of assigning one out of two values to the pairs of configurations, they were equivalent to possible subsets of a set of $\frac{m}{2}$ elements and formed the elements of a Boolean algebra. Several example calculations are given. G.G.

N66-12304 Computer Usage Co., Inc., Palo Alto, Calif.
VACUOUS VARIABLES OF PARTIAL FUNCTIONS Research Note 14
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 15 p refs (See N66-12301 03-19)

Considered was a partial switching function of two variables, where (—) indicates an undefined configuration as

x_2 \ x_1	0	1
0	—	0
1	1	— ,

and illustrates the fact that a partial function can be vacuous in two variables independently but not jointly. Calculations and theorems were presented that show how the possible vacuous subsets of variables may be characterized and some of the properties of these subsets are demonstrated. G.G.

N66-12305 Computer Usage Co., Inc., Palo Alto, Calif.
VARIABLES IN SUBSETS A AND B Research Note 15
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 20 p (See N66-12301 03-19)

Considered was the decomposition f(A,B,C,D) = g(ϕ(A,B, C),C,D) where the variables in sets A and the subsets of variables in D are given. Calculations were performed on the subsets of variables which may be contained in B and in C. It was found that if there exists any distribution of variables between B and C that gives rise to a decomposition then the distribution will be all k variables in C and none in B. The subfunctions of these decompositions may contain vacuous variables. Examples for switching functions of seven variables are presented. G.G.

N66-12306 Computer Usage Co., Inc., Palo Alto, Calif.
EXTENSION OF PREVIOUS RESULTS TO SIMPLE DECOMPOSITIONS WITH $[\phi] = 2$ IN FUNCTIONS WITH $\rho \geq 2$ AND $\kappa \geq 2$ Research Note 16
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 11 p (See N66-12301 03-19)

Described is an extension of simple decompositions with $[\phi] = 2$ to total discrete functions in which $\rho \geq 2$, and $\kappa \geq 2$. It was assumed that the function f(A,B,C,D) is decomposable to the form g(ϕ(A,B,C),C,D). An expansion function having variables with a range greater than two can be defined provided that: (1) the total number of configurations of the variables A is p, that of B is q, and of C, r; and (2) that corresponding to the i^{th} configuration of the variables A, the j^{th} configuration of B, and the k^{th} of C, the value of β(A,B,C) will be β_{ijk}. G.G.

N66-12307 Computer Usage Co., Inc., Palo Alto, Calif.
EXTENSION OF PREVIOUS RESULTS TO SIMPLE DECOMPOSITIONS IN WHICH $[\phi] \geq 2$ Research Note 17
In its Strategies of Function Decomposition for artificial Intelligence, Vol. II 1 Jul. 1965 8 p (See N66-12301 03-19)

The following theorem was used to establish correspondence between a frontal switching function and subsets of variables for which a decomposition exists: Let $f(x_1, x_2, \ldots, x_n)$ be an arbitrary total or partial discrete function with arbitrary range and with variables having arbitrary ranges. Let A, B, and C be disjoint and mutually exhaustive subsets of variables. The existence of the decomposition f(A, B, C) = g (ϕ(A,B), B, C), implies the existence of a number of decompositions for which theorems were formed. Results provide the basis for formulating efficient algorithms for the detection of economical simple decompositions in given total and partial discrete functions. G.G.

N66-12308 Computer Usage Co., Inc., Palo Alto, Calif.
LOWER BOUNDS ON THE DECOMPOSITION COST OF NEARLY ALL PARTIAL FUNCTIONS Research Note 18
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 4 p (See N66-12301 03-19)

The lower bounds on the decomposition cost for a class of partial valued functions of n, p-valued variables having defined configurations of variables, were studied by extending the definition of decomposition costs to include partial functions. Since the cost of an undecomposed partial function is equal to the number of defined configurations of its variables, decompositions, including partial subfunctions, will have costs equal to the total cost of all subfunctions. G.G.

N66-12309 Computer Usage Co., Inc., Palo Alto, Calif.
REMARKS ON COST MEASURES Research Note 19
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 14 p (See N66-12301 03-19)

It is shown that a cost measure for an undecomposed function or subfunction cost of $p^n \log k$ permits induction over k, this leads to essentially the same results as cost measures where the definition of the factor $\hat{K}_\alpha$ rests upon an induction of the simulation cost α_n over n and on the number of variables in a subfunction. It was stipulated that the cost of an undecomposed function is equal to the product of the number of configurations of its variables and the logarithm of its range. Since the cost of any decomposition of a function is equal to the sum of all the individual undecomposed subfunctions contained in the decomposition, it was proven that an undecomposed k-valued function of n, p-valued variables has a cost of $p^n \log k$. G.G.

N66-12310 Computer Usage Co., Inc., Palo Alto, Calif.
FURTHER REMARKS ON COST MEASURES Research Note 20
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 6 p (See N66-12301 03-19)

Calculations showed that any positive charge for interconnections or wiring costs of constructions used to provide an upper bound on the cost of an arbitrary function, will yield a cost which for sufficiently large n, increases at a rate greater than 2^n. This was demonstrated for the case of relay networks with interrelating subfunctions and variables. G.G.

N66-12311 Computer Usage Co., Inc., Palo Alto, Calif.
MEASURES OF INTERCONNECTION COSTS Research Note 21
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 4 p (See N66-12301 03-19)

Cost measures properties for functions were studied with emphasis on their decompositions which account for the cost of interconnections and interrelations between subfunctions. Binary digits were used to define all subfunctions and to specify their interrelations, and an additional number of binary digits was added to describe the cost of decomposition. It was assumed that n, the number of primitive variables of a function, plus the number of subfunctions in a decomposition was equal to p, and that the number of subfunction variables was q; least $p \log_2 q$ binary digits were used to specify any one of the possible interrelations between subfunctions and variables. G.G.

N66-12312 Computer Usage Co., Inc., Palo Alto, Calif.
ECONOMICAL DECOMPOSITIONS AND GENERALIZATION Research Note 22
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 9 p (See N66-12301 03-19)

The black-box mechanization of some unknown discrete functions selected at random from a specific population of functions was studied. Generalization was performed by adjusting the input variables to some desired configuration and to measure the value of the output function. A detailed analysis of total switching functions ($k = 2$, $p = 2$) of the n variables ($x_1, x_2, \ldots, x_n$) containing a non-overlapping decomposition of the form: $f(x_1, x_2, \ldots, x_n) = g(\phi(A), B)$, where $\phi(A)$ is a switching function is given. The population of the problem was generated by combining each possible subfunction $\phi(A)$ exactly once with each subfunction $g(\phi, B)$. It was found that for sufficiently large n, with a probability of $1 - \delta$, the function can be defined with no more than $(1 + \epsilon)$ ([A] + 2[B]) experiments, where ϵ and δ are arbitrarily small positive numbers. G.G.

N66-12313 Computer Usage Co., Inc., Palo Alto, Calif.
DETECTION OF VARIABLE SUBSETS IN THE GENERALIZATION PROBLEM Research Note 23
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 9 p (See N66-12301 03-19)

Considered was a discrete function for a population consisting of the total switching functions ($k = 2$, $p = 2$) of the n variables ($x_1, x_2, \ldots, x_n$) containing the non-overlapping decomposition $f(x_1, x_2, \ldots, x_n) = g(\phi(A), B)$, where $\phi(A)$ is a switching function. The exact population was generated by combining each possible subfunction for each possible subset of variables exactly once with each possible subfunction of the remaining variables, but where the assignment of the variables $x_3, \ldots, x_n$ to sets A and B is unknown. It was concluded that less than $8m(n-2)$ experiments will be required to allocate the variables to sets A and B with a good probability. G.G.

N66-12314 Computer Usage Co., Inc., Palo Alto, Calif.
COST MEASURES AND DECOMPOSITIONS OF CONTINUOUS VARIABLES AND FUNCTIONS Research Note 24
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 8 p (See N66-12301 03-19)

Cost measures and decomposition properties for continuous variables and functions were developed by treating them as the limiting case of corresponding functions. Considered were continuous variables and function values in conventional two-valued radix representation where a continuous function of n continuous variables becomes equivalent to a discrete function of nm binary variables. Discrete functions of two m digit binary numbers were represented by a 2m digit binary number. Decompositions of discrete approximations to certain common continuous function were treated by: (1) Sharing subfunctions of the decomposition so that a single subfunction may enter into the evaluation of more than one output; and (2) summation of the costs of all the undecomposed subfunctions to establish the cost of a multiple output decomposition. Example decomposition procedures are shown. G.G.

N66-12315 Computer Usage Co., Inc., Palo Alto, Calif.
REVIEW AND DISCUSSION OF NOTES 1-24 Research Note 25
In its Strategies of Function Decomposition for Artificial Intelligence, Vol. II 1 Jul. 1965 11 p (See N66-12301 03-19)

Results in this study are reviewed and their possible extension to form a comprehensive theory is discussed. Strategies of function decomposition solely from variations of input configurations and of output function values were studied for discrete, finite, deterministic functions, as well as arbitrarily close discrete approximations to continuous functions of continuous variables. Non-deterministic, and sequential functions were not included. Work done thus far is broken down into the following interrelated areas: (1) Decomposition costs and the equivalence of all measures of cost or complexity; (2) detection of economical decomposition; and (3) generalizing properties of economical decompositions. Roughly, the method applied consisted of selecting a function at random from a defined population of functions, and attempting to define (or equivalently to mechanize) the function completely from input-output observations using as few observations as possible. It was concluded that if sufficient subfunction information is available for a generalization problem, then it can be solved for any economical decomposition, composite or non-composite. G.G.

N66-12342# Joint Publications Research Service, Washington, D. C.
TEST FOR REPRESENTABILITY OF EVENTS IN FINITE PROBABILITY AUTOMATA
R. G. Rukharayev 19 Nov. 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 164, no. 2, 1965 p 289–291
(JPRS-32940; TT-65-33517) CFSTI: $1.00

The language of finite-dimensional vector functions is used to formulate a test for the representability of events in finite probability automata. Conditions are set for defining the automaton-finite vector function, and appropriate theorems are evolved. An example is also given of an event which is not representable in any finite probability automaton, and it is questioned whether such an event can be nonrecursive. M.W.R.

N66-12384# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.
DISCUSSION OF A NON-LINEAR DIFFERENTIAL EQUATION CONTAINING EXCEPTIONAL POINTS
Karl G. Guderley Jul. 1965 75 p
(ARL-65-141; AD-622070)

A theoretical treatment of spherical plasma probes in the Vlassov approximation leads to a non-linear ordinary differential equation which has somewhat exceptional properties. Certain mathematical phenomena caused by this fact are studied in the present report. Within the region of integration, one encounters certain points for which a Lipschitz condition is not satisfied; fortunately, a weaker condition suffices to establish uniqueness of the initial value problem in the present case. Next, one asks whether the solutions of the variational equation are suited to approximate neighboring solutions for a given solution. Two cases are discussed where the variational equation will yield such an approximation. In a third case, the approximation fails in the vicinity of the exceptional point. Here an auxiliary approximation valid for this vicinity is introduced and the auxiliary solution is matched with the solution of the variational equation. The result is somewhat unexpected. Finally, the actual numerical procedure is discussed. No definite conclusion can be reached, but one recognizes which form of intermediate approximations may cause numerical difficulties.
Author (TAB)

N66-12465# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE TWO-SIDED CHAPLYGIN APPROXIMATIONS OF THE SOLUTION OF TWO-POINT BOUNDARY PROBLEMS
G. V. Gendzhoian 6 Nov. 1963 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk (Gorky), v. 17, no. 3, 1964 p 21–26

Two-sided Chaplygin approximations to the solution of the boundary value problem $P(y) = -y'' + f(x, y, y') = 0$, $0 < x < 1$; $y(0) = y(1) = 0$, are constructed, and their convergence to the solution is proved. The following conditions are imposed on the function f: it is continuous in x, y, and y' in the domain $0 \leq x \leq 1$, $y^2 + y'^2 < \infty$, and is continuously differentiable with respect to y and y' in the domain $0 \leq f_y \leq M$, $|f_{y'}| \leq M$. C.T.C.

N66-12466# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON CERTAIN PROPERTIES OF CAUCHY FUNCTIONS
R. G. Aliev, V. V. Ostroumov, and S. A. Pak 4 Nov. 1962 5 p rdfs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., MHT. (Kazan), no. 4(41), 1964 p 9–11

Certain properties of Cauchy functions are presented as an extension to the work of N. V. Azbelev and Z. B. Tsaliuk. E.E.B.

N66-12467# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE EXISTENCE OF UPPER AND LOWER SOLUTIONS OF THE CAUCHY PROBLEM OF A SECOND ORDER DIFFERENTIAL EQUATION
S. A. Pak and E. S. Chichkin 21 Jan. 1963 5 p refs Transl. into ENGLISH from Izv. Vysshikh Ucheb. Zhvedénii, Mat. (Moscow), no. 5(42), 1964 p 91–94

A refinement is proposed for some previously obtained results of the existence of upper and lower solutions of differential and integral equations. Using specific singularities, the equation $N[y] \equiv y'' - f(x, y) = 0$, $y(x_0) = y_0$, $y'(x_0) = y'_0$, is considered. C.T.C.

N66-12469# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE QUESTION OF SPECIFIC CRITERIA FOR ESTIMATES OF THE LENGTHS OF SUBCRITICAL INTERVALS
R. G. Aliev [1964] 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mat. (Kazan), no. 5(42), 1964 p 3–7

Certain laws of the distribution of zeros are considered for a linear fourth order differential equation with summable coefficients. Specific criteria for estimates of the lengths of subcritical intervals are examined, and conditions are presented for the solution not to have four different zeros and a pair of multiple zeros in a given interval. C.T.C.

N66-12504# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
AN INTERPOLATION CURVE USING A SPLINE IN TENSION
Daniel G. Schweikert Apr. 1965 31 p refs
(Contract Nonr-562(36)
(AD-620888)

The use of a linearized mathematical spline for interpolation between given points occasionally yields extraneous inflection points which for some applications, notably the fairing of ship lines, are not acceptable. To avoid this difficulty, a spline in tension is considered and the value of tension which is sufficient to remove all the extraneous inflection points is determined. The slopes of the interpolating curve at each of the given stations are considered as the unknowns and can be calculated without the necessity of numerical matrix inversion. Author (TAB)

N66-12542# Stanford Univ., Calif. Dept. of Statistics.
ON EMPIRICAL MULTIPLE TIME SERIES ANALYSIS
Emanuel Parzen 19 Jul. 1965 68 p refs Presented at the 5th Berkeley Symp. on Math. Statistics and Probability Theory, Jul. 1965
(Contract Nonr-225(80); Grant NSF GP-4265)
(TR-3; AD-621304)

It is natural to think of the theory of time series analysis as composed of two parts, foundations (a probabilistic part involving deep mathematics and based on the unrealistic assumption that one knows the probability law of the time series) and empirical (in which one considers statistical and computational procedures). This paper outlines the problem of empirical multiple time series analysis, indicates some theoretical questions which require further investigation, presents a unified but heuristic exposition of cross spectral analysis, and states some new results on the asymptotic sampling theory of partial cross-spectra. Author (TAB)

N66-12543# California Univ., Berkeley. Dept. of Mathematics.
WALSH FUNCTIONS, NORMAL NUMBERS AND PSEUDO-RANDOM FUNCTIONS
Michel M. France Sep. 1965 19 p refs
(Contract Nonr-222(60))
(AD-621360)

The so-called Walsh functions are considered. They are defined as a character on the abelian group (Z/gZ) to the Nth power (g is a given integer > or =2). A characterization is obtained of normal numbers of applying Weyl's criteria on uniformly distributed sequences on a group. It is shown that the Walsh functions are pseudo-random functions whose energetic spectral density is singular. Author (TAB)

N66-12554# Texas Univ., Austin.
INVESTIGATION OF TIME DOMAIN IDENTIFICATION TECHNIQUES
Arthur John Deex (Ph.D. Thesis) Jul. 1965 120 p refs
(Contract AF 33(608)-1121)
(AD-620392)

Methods are investigated of identifying a rational transfer function in the complex frequency, s, domain, given the impulse response or samples of the impulse response of a time invariant or slowly time varying system. This problem arises in adaptive schemes where g (t), the impulse response of the plant, is characterized by a preliminary identification method. The next step in the identification process is that of determining the coefficients of G (s), the rational transform of g (t). Adaptation is based on the form G (s) and the value of the coefficients of G (s). Several time domain synthesis techniques including least-square fitting, indices of matching, moment matching, and orthogonal methods are considered with a view to digital identification. The analog method of transfer function tracking of Puri and Weygandt is applied to digital identification. TAB

N66-12594# North Carolina State Coll., Raleigh. Dept. of Mathematics.
BAER RINGS AND LINEAR TRANSFORMATIONS
Charles Howard Wheeler (M.S. Thesis) 1965 31 p refs
(Contract AF 33(608)-1092)
(AD-620447)

The first five sections of this thesis are devoted to proving that the ring of all n X n triangular matrices over any field, which is not necessarily commutative, belong to the class of Baer rings for any finite n. The term Baer ring is used to denote those rings in which the left (right) annihilator of each subset is a principal left (right) ideal generated by an element, say e, in the ring, with the property e·e = e. The sixth section is devoted to proving that in a Baer ring certain ideals, called right and left singular ideals, contain no non-zero elements. The left (right) singular ideal of a ring is a set of elements of the ring whose left (right) annihilators have a non-zero intersection with each non-zero left (right) ideal of the ring. Some indications of why these proofs are significant, a summary of the thesis, and remarks on possible extensions of this work, are the contents of the seventh section. Author (TAB)

N66-12793# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
TABLES FOR THE DISTRIBUTION OF THE MAXIMUM OF CORRELATED CHI-SQUARE VARIATES WITH ONE DEGREE OF FREEDOM
P. R. Krishnaiah and John V. Armitage Jul. 1965 152 p refs
(ARL-65-136; AD-620908)

The distribution of the maximum of correlated chi-square variates with one degree of freedom plays an important role in the simultaneous test procedures and ranking and selection procedures. In this paper, extensive tables are given of the probability integrals of this distribution along with certain percentage points for the equicorrelated case. The use of these tables in applying a simultaneous test procedure is also discussed. TAB

N66-12794# ARCON Corp., Lexington, Mass.
FIXED SIZE CONFIDENCE ELLIPSOIDS FOR LINEAR REGRESSION PARAMETERS
Arthur Albert Jul. 1965 62 p refs
(Contract Nonr-4905(00))
(AD-619728)

An asymptotic theory of fixed width sequential confidence intervals for the mean of a univariate population is reviewed, with application of the stopping rule to the problem of constructing fixed size confidence sets for linear regression parameters. The confidence regions proposed are the more conventional ellipsoidal ones, and at the same time the theory to include estimable functions of the regression vector is developed. Having done so, it is shown that it is a simple task to adapt the results to the construction of sequential tests of the General Linear Hypothesis. It is also pointed out that the methods used require that the least squares estimator for the regression parameter and its associated residual error be updated constantly as each datum is taken. To facilitate the attendant computations, algorithms are supplied which allow these quantities to be computed iteratively in "real time" (as the data are collected). Formulas are also given for the exact coverage probabilities for normally distributed residuals. R.R.D.

N66-12807# California Univ., La Jolla.
MECHANISMS OF SPATIAL SUMMATION
James L. Harris, Sr. May 1965 24 p refs
(Contract Nobs-86012)
(Rept.-2; AD-619591)

A number of investigators have postulated several mechanisms to account for the spatial summation which is exhibited by the human visual system. This report describes the results of an investigation to determine the extent to which retinal image quality together with the probability summation due to simultaneous simulation of many receptors can account for the experimental evidence. It is shown that these two mechanisms are sufficient to produce the degree of spatial summation exhibited by the visual system and that the resulting visual performance is compatible with quantum limitations. Author (TAB)

N66-12815# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
BEST LINEAR UNBIASED ESTIMATORS OF THE PARAMETERS OF THE LOGISTIC DISTRIBUTION USING ORDER STATISTICS
S. S. Gupta, A. S. Qureishi (Serivce Bureau Corp.), and B. K. Shah (Yale Univ.) [1965] 48 p refs
(Contract AF 33(657)-11737)
(Rept.-2; AD-621150)

Let $X_{1,n} \leq$ or = $x_{2,n} \leq$ or = ... $\leq$ or = $x_{n,n}$ be the n order statistics from a logistic distribution with mean m and standard deviation s, respectively. The best linear estimators of the type $\xi a_{i,n}\ x_{i,n}$ and $\xi b_{i,n}\ x_{i,n}$ where the ξ extends from r_1+1 to $n-r_2$ and where r_1 and r_2 are the missing observations in the beginning and at the end (i.e. censored case). Tables of $a_{i,n}$ and $b_{i,n}$ are given for n = 2 (1)25 for selected values of r_1 and r_2. The variances and covariances of these

estimators are also given and relative efficiencies are evaluated. A table of the covariances of these estimators are also given and relative efficiencies are evaluated. A table of the covariances of these estimators are also given and relative efficiencies are evaluated. A table of the covariances for n = 11 (1)25 of all order statistics is also provided. Author (TAB)

N66-12819# Massachusetts Inst. of Tech., Cambridge.
THE NUMERICAL SOLUTION OF BOUNDARY VALUE PROBLEMS
John William Lucey (Ph.D. Thesis) Jun. 1965 117 p refs
(Grant AF-AFOSR-341-63)
(AFOSR-65-1279; AD-621201)

The marchout method is extended to the numerical solution of second order 2-dimensional inhomogeneous problems and the one velocity neutron transport equation. In the method the solution is expanded in a full set of vectors which are used in an unstable difference equation. The error growth is controlled, however, by periodic matrix transformations which insure the completeness of the vector set. The error in the solution is determined by the frequency of these transformations and may be preset. The method has its greatest advantage in relation to the computational speed of conventional methods in elongated meshes, such as multigroup diffusion calculations or low order discrete ordinate or P_N calculations with many spatial mesh points. Author (TAB)

N66-12832# RAND Corp., Santa Monica, Calif.
QUASILINEARIZATION, INVARIANT IMBEDDING, AND THE CALCULATION OF EIGENVALUES
Richard Bellman, Harriet Kagiwada, and Robert Kalaba Sep. 1965 19 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4738-PR; AD-621455)

Several eigenvalue problems for systems of ordinary differential equations are considered. They are resolved computationally using the quasilinearization technique, a quandratically convergent successive approximation scheme. The essential idea presented is to consider an eigenvalue problem to be a system identification problem. Also shown is the use of invariant imbedding techniques to obtain good initial estimates for eigenvalues in some neutron multiplication processes. Author (TAB)

N66-12837# RAND Corp., Santa Monica, Calif.
ON ANALOGUES OF POINCARE-LYAPUNOV THEORY FOR MULTIPOINT BOUNDARY-VALUE PROBLEMS
Richard Bellman Sep. 1965 16 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4717-PR; AD-621869)

A study of control theory and of its application to the guidance of mechanical, electronic, economic, and other processes. The solution of a number of its deterministic problems requires the minimization of a certain functional. The memorandum considers the behavior of such solutions as the duration of control becomes infinite. Author (TAB)

N66-12969*# Pittsburgh Univ., Pa. Space Research Coordination Center.
PROJECTIVE-SYMMETRIC SPACES
R. F. Reynolds and A. H. Thompson 22 Oct. 1965 14 p refs
Submitted for Publication *Its* Rept.-16
(Grant NsG-416)
(NASA-CR-68311) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Projective-symmetric spaces, in which the first covariant derivative of Weyl's projective curvature tensor is everywhere zero, are discussed. It is pointed out that all Riemannian spaces with this property are symmetric in the sense of Cartan; that is, the first covariant derivative of the Riemann curvature tensor of the space vanishes. The application of this theorem to projective-symmetric affine spaces with symmetric affine connection is described. M.G.J.

N66-13063# European Atomic Energy Community, Brussels (Belgium).
LINEAR INEQUALITIES ON A TOTAL ORDERED LINEAR INTEGER RING (APPLICATIONS TO THE LINEAR PROGRAMMATION AND TO THE GRAPHS THEORY) [INEGALITES LINEAIRES SUR UN ANNEAU D'INTEGRITE TOTALEMENT ORDONNE (APPLICATIONS A LA PROGRAMMATION LINEAIRE ET A LA THEORIE DES GRAPHES)]
P. Camion 1965 33 p refs In FRENCH; ENGLISH summary
(EUR-1919.f) CFSTI: HC $2.00/MF $0.50

A theory of linear programming available on linear ordered integer rings is presented. It only uses the notion of interval, and not the notion of convexity. By this means, we improve the known results on feasibility of systems of linear inequalities. New algorithms are given in linear programming and it is shown how a whole chapter in graph theory belongs to this theory. Author

N66-13064# Joint Publications Research Service, Washington, D. C.
AUTOMATA FORECASTING A RANDOM PROCESS
K. S. Kholevo 3 Dec. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 14, no. 3, 1965 p 515–518
(JPRS-33151; TT-65-33727) CFSTI: $1.00

The theory of the prognosis of random processes enables the construction of the best prognosis starting from known spectral or correlation functions. However, frequently the correlation function is not known and is calculated after the observation of a sufficiently large segment of the process. It is shown that such a problem can be solved by an asymptotic optimal sequence of automata. Processes with discrete time which take two different values (0 and 1) are considered. Such binary processes in the assumed approximation are the model of processes taking place in the nerve fibers and the corresponding automata have the structure of nerve nets. The random process is limited by the following: the process must be Markovian, uniform, N-dependent, and have a final probability distribution. E.E.B.

N66-13065# Joint Publications Research Service, Washington, D. C.
ALL-UNION CONFERENCE ON MATHEMATICAL OPTIMAL PROGRAMMING
A. Fridman 8 Dec. 1965 5 p Transl. into ENGLISH from Ekon. i Mat. Metody (Moscow), no. 5, 1965 p 805–807
(JPRS-33215; TT-65-33790) CFSTI: $1.00

The proceedings of a conference on optimal mathematical programming which was held by the Academy of Sciences of the Soviet Union are briefly summarized. Over 500 persons from the Soviet Union and Soviet-block countries participated in the conference. Only a few of the more interesting reports are reviewed. Among these are the following: *Economic Applications of Mathematical Programming; Numerical Methods for the Solution of Nonlinear Optimization Problems; Non-economic Applications of Mathematical Programming; Methods of Convex Programming; Linear and Nonlinear Programming; Integral Programming and Multiextreme Problems;* and *Methods of Successive Approximations for Resolution of Optimal Control.* E.E.B.

N66-13169*# Midwest Research Inst., Kansas City.
RATIONAL APPROXIMATIONS TO THE SOLUTION OF THE SECOND ORDER RICATTI EQUATION Technical Report, 15 Jan.–14 Oct. 1965
Wyman Fair and Yudell Luke [1965] 11 p refs
(Contract NASr-63(07))
(NASA-CR-68503) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Continued fraction approximations to the solution of a second order nonlinear equation were developed. These include: (1) the equations constructed for continued fraction solutions to the first order Ricatti equation by using a sequence of linear fractional transformations, and (2) the use of the τ-method to develop main diagonal Padé approximations to the solution of the first order Ricatti equation with rational coefficients. These approximations are obtained by using a sequence of linear transformations which leave the differential equation invariant. Two examples which exhibit the utility of these approximations when used to approximate both the function and its poles are considered. The algorithm is applied to obtain approximations to Painlevé s first and second transcendents. M.G.J.

N66-13216# Princeton Univ., N. J. Dept. of Graphics and Engineering Drawing.
GRAPHICAL PLOTTING OF DATA: AN APPLICATION OF THREE AND FOUR DIMENSIONAL THEORETICAL DESCRIPTIVE GEOMETRIES
C. Ernesto S. Lindgren (U.S. Steel Corp.) Mar. 1965 42 p *Its* Spec. Rept.-5
(AD-621289)

The paper introduces new methods of graphical plotting by means of theoretical four-dimensional descriptive geometry, re-introduces known methods derived from theoretical three-dimensional descriptive geometry and compares the latter with the usual two-dimensional plotting characterized by a third parameter to indicate the three-dimensionality of the representation. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-12258*# National Aeronautics and Space Administration, Washington, D. C.
INFLUENCE OF TROPOSPHERIC PROCESSES ON CHANGES IN THE TEMPERATURE FIELD AND CIRCULATION IN THE STRATOSPHERE [O VLIYANII TROPOSFERNYKH PROTSESSOV NA IZMENENIYE POLYA TEMPERATURY I TSIRKULYATSII V STRATOSFERE]
Kh. P. Pogosyan Dec. 1965 29 p refs Transl. into ENGLISH from Meteorol. Issled. (Moscow), no. 9, 1965 p 30–51
(NASA-TT-F-397) CFSTI: HC $2.00/MF $0.50 CSCL 04B

Results of study of the influence of the tropospheric processes on air circulation in the stratosphere are presented in this paper. It is shown that intensively developing tropospheric vortexes, particularly over the continents during the winter, influence substantially the change of circulation in the lower stratosphere. The rising large scale turbulence exchange, followed by advection and convective motions covering both the troposphere and stratosphere, is of great importance in this process. This paper also presents the information about the synchronic change of geopotential both in the troposphere and stratosphere, the height up to which the atmospheric vortexes extend during the winter, etc. Author

N66-12259*# National Aeronautics and Space Administration, Washington, D. C.
SEASONAL RECONSTRUCTION OF THE WIND FIELD IN THE STRATOSPHERE [SEZONNAY PERESTROYKA POLYA VETRA V STRATOSFERE]
K. Ye. Speranskiy Dec. 1965 10 p refs Transl. into ENGLISH from Meteorol. Issled. (Moscow), no. 9, 1965 p 52–57
(NASA-TT-F-398) CFSTI: HC $1.00/MF $0.50 CSCL 04B

Some wind characteristics in the stratosphere during the different seasons of the year are discussed on the basis of measurements obtained by the Meteorological Rocket Network of the USA during 1959 and 1960 and the USSR during the IGY. Author

N66-12261*# National Aeronautics and Space Administration, Washington, D. C.
CLIMATOLOGY OF NOCTILUCENT CLOUDS ACCORDING TO OBSERVATIONS PERFORMED DURING THE IGY [KLIMATOLOGIYA SEREBRISTYKH OBLAKOV PO NABLYUDENIYAM V PERIOD MGG]
V. V. Sharanov Dec. 1965 12 p Transl. into ENGLISH from Meteorol. Issled. (Moscow), no. 9, 1965 p 143–149
(NASA-TT-F-400) CFSTI: HC $1.00/MF $0.50 CSCL 04B

The paper contains data of noctilucent cloud distribution with respect to dates, latitudes and longitudes for the IGY period. These data are obtained by a large network of the USSR Hydrometeorological Service stations. Author

N66-12300# Joint Publications Research Service, Washington, D. C.
AEROMETEOROLOGICAL RESEARCH IN ANTARCTICA DURING THE IGY [AEROMETEOROLOGICHESKAYA IZUCHENNOST' ANTARKTIKI V SVYAZI S PROVEDENIYEM MGG]
L. V. Dolganov 17 Nov. 1965 101 p refs Transl. into ENGLIGH from the Soviet monograph, Arctic and Antarctic Sci. Res. Inst. (Leningrad), 1964 64 p
(JPRS-32909; TT-65-33486) CFSTI: $3.00

This book describes the organization of research and the content of meteorological, actinometric, aerological and gradient observations and also work in the field of synoptic meteorology at the Antarctic stations of the Soviet Union and other countries for the most part for the period of the International Geophysical Year, but for some stations for the succeeding years as well. The book also describes aerometeorological work at temporary movable stations and on sea expeditions, as well as observations from aircraft. The monograph is intended for scientific specialists, instructors, graduate students and students in departments of geography and hydrometeorology and also for everyone interested in the Antarctic region. Author

N66-12326# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALL-UNION SCIENTIFIC METEOROLOGICAL CONFERENCE. TRANSACTIONS Selected Articles
9 Jul. 1965 29 p refs Transl. into ENGLISH from Tr. Vses. Nauchn.-Issled. Inst. Metrol. (Leningrad), v. 6, 1963 p 60–68, 102–111
(FTD-MT-64-367; AD-619471)

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2. RESULTS OF EXPERIMENTAL RESEARCH OF OPTICAL DENSITY OF CLOUDS G. M. Zabrodskiy p 14–25 refs (See N66-12328 03-20)

N66-12327 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESULTS OF INVESTIGATION OF AEROSOLS BY OPTICAL METHODS

A. G. Laktionov *In its* All-Union Sci. Meteorol. Conf. Trans. 9 Jul. 1965 p 1–13 (See N66-12326 03-20)

Distribution of particles of natural aerosol in free atmosphere is investigated, with emphasis placed on particles with dimensions of $r > 1$ micron. Both spherical liquid particles and solid particles of irregular shape were measured by two specially-designed analyzers. A laboratory analyzer was used for counting the smaller particles; and a more compact field analyzer counted particles with $r > 3$. Optical circuits of both are illustrated; the essential difference between the two is that the field analyzer has a photomultiplier. An electronic-mechanical pulse recorder permits automatic counting up to 2.10^4 pulses/sec. The laboratory analyzer counts particle density with an error of less than 7% with concentrations up to 800 particles/cm^3; the field analyzer used from an aircraft will do the same with concentrations of up to 70 particles/cm^3. Nephelometric investigation of aerosol from aircraft produces slight heating, which can lead to distortion in measurements. Nephelometers are not accurate when the relative humidity is more than 70%. Spectra are shown for distribution of particles (by their dimensions) above different underlying surfaces. M.W.R.

N66-12328 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESULTS OF EXPERIMENTAL RESEARCH OF OPTICAL DENSITY OF CLOUDS

G. M. Zabrodskiy *In its* All-Union Sci. Meteorol. Conf. Trans. 19 Jul. 1965 p 14–25 refs (See N66-12326 03-20)

Data on cloud density obtained from oscillograms are presented for the summer months. It is shown that the optical density of stratiform clouds increase with rise in altitude, with maximum density attained at the upper boundary. Temperature of clouds near the upper boundary differs from that of the neighboring air when there are no cloudy layers above the strati. As a rule, the upper boundary of the strati coincides with the beginning of an inversion layer, which is frequently penetrated by stratocumuli. Changeability of optical density of clouds is discussed as is the temperature field of stratified clouds. M.W.R.

N66-12463# Joint Publications Research Service, Washington, D. C.

THE RELATIONSHIP BETWEEN THE TRANSPARENCE OF THE FREE ATMOSPHERE AND CERTAIN METEOROLOGIC CHARACTERISTICS

G. P. Faraponova 12 Nov. 1965 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atm. i Okeana (Moscow), v. 1, no. 6, 1965 p 607–614
(JPRS-32839; TT-65-33417) CFSTI: $1.00

Some relations are obtained between the aerosol component of the dimming index K_λ aeros ($\lambda_{eff} = 0.44$ mc) of the separate layers of the atmosphere and the humidity characteristics. A change was discovered in the transparence of the atmosphere during 24 hours. The role of temperature inversions in the distribution of the dimming index with altitude is noted. Author

N66-12550# Wisconsin Univ., Madison.

INTERRELATION OF IONOSPHERIC SPORADIC E WITH THUNDERSTORMS AND JET STREAMS

Thomas Deloyd Damon (M.S. Thesis) 1965 42 p refs
(Contract AF 33(608)-1133)
(AD-620396)

Reports of the occurrence of ionospheric sporadic E clouds from radio amateurs operating on a frequency near fifty megahertz are analyzed on a synoptic scale and compared with the occurrence of thunderstorms and of jet streams. A mechanism is suggested for the observed interrelation between Es and thunderstorms. No definite conclusion is drawn concerning the possible relationship between Es and jet streams. Author (TAB)

N66-12588# Texas A&M Univ., College Station. Dept. of Oceanography and Meteorology.

A STUDY TO IMPROVE THE LOW-LEVEL METEOROLOGICAL SIMULATOR Second Quarterly Report, 1 Apr.–30 Jun. 1965

William H. Clayton 12 Jul. 1965 25 p
(Contract DA-36-039-AMC-02195(E))
(Rept.-10; AD-621728)

The purpose of this study is to improve the model utilized in the Low-Level Meteorological Simulator previously developed and to investigate extension of this model, particularly with regard to inclusion of fog and low level jet phenomena. The contractual efforts have for the most part consisted of modification and maintenance efforts on the GPAC in preparation for Section V evaluation of the selected meteorological cases. Author

N66-12609# St. Louis Univ., Mo.

AN ANALYSIS OF NUMERICAL CLOUD FORECASTS: A STATISTICAL ANALYSIS OF TOTAL CLOUD COVER FORECASTS PRODUCED BY TWO AIR WEATHER SERVICE NUMERICAL PROGRAMS

Robert Edward de Michaels (M.S. Thesis) 1965 31 p refs
(Contract AF 33(608)-1115)
(AD-620439)

The Air Weather Service, USAF, has a requirement to provide total cloud cover forecasts for the northern hemisphere. Three approaches were made to provide numerical forecasting programs to meet this requirement: (1) A 'Dynamic Cloud Forecasting Model' based upon forecasting the trajectories of air parcels; (2) A '4-layer Cloud Forecasting Model' based upon the forecasting of adiabatic vertical velocities and a statistical correlation between cloud cover and the forecast dewpoint depression; and (3) a 'Multiple-discriminant Analysis' program developed by applying statistical techniques to determine a minimum number of predictors which would most efficiently forecast total cloud cover by statistical methods. TAB

N66-12613# Meteorology Research, Inc., Altadena, Calif.

ANALYSIS OF FLAGSTAFF DATA First Quarterly Report, Nov. 1, 1964–Jan. 31, 1965

Paul B. Mac Cready, Jr., Theodore B. Smith, and Donald M. Takeuchi [1965] 24 p refs
(Contract DA-28-043-AMC-00406(E))
(Rept.-1; AD-619978)

The work of the present project consists of four subjects: (1) Precipitation mechanisms and droplet coalescence, (2) case studies of seeded clouds, (3) cloud and storm development, and (4) electrification. The major effort to date has gone into item 1, specifically in developing the data handling aspects of the records from the continuous particle sampler including setting up a computer program to transform replica distributions into droplet distributions, and in trying to understand and evaluate the various error factors involved. The system now permits the rapid handling of sampler data so that the study of precipitation mechanisms and seeded clouds can proceed efficiently, and the accuracy of the droplet data evaluation has been greatly improved. The data obtained from ascents up within cumulus cores still suggests but does not prove that significant coalescence is taking place between small droplets in the 5–10 micron diameter range. Author (TAB)

N66-12754 Joint Publications Research Service, Washington, D. C.

THE FORMATION OF THE SECOND MAXIMUM IN THE CLOUD GRAPH

Lin Hai *In its* Transl. on Communist China's Sci. and Technol., No. 244 23 Nov. 1965 p 25–31 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 10, Oct. 1965 p 923–925 (See N66-12751 03-34) CFSTI: $3.00

Minute characteristics of the second maximum in the cloud graph or twin-peak graph are the same as those found in other drops in the clouds or fog. Twin-peaks occur at the same time as the stronger turbulent current movement and the rising draft of air, and can generally be observed in the cumulus region. Appearance of the twin-peak graph is always accompanied by a widening of the cloud graph. When the second maximum of big drops appears, the cloud graph narrows. Diameter of the second maximum big drops ranges from 20 to 30μ. Numerical calculations are made and cloud graphs are presented. M.W.R.

N66-12777# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

CUMULUS CONVECTION AND OROGRAPHIC CONVECTION CELLS Final Report, 1 Dec. 1964–31 May 1965

Herbert Riehl [1965] 51 p refs
(Contract DA-36-039-SC-89080)
(AD-621866)

The general goal of this research is to investigate various aspects of the monsoon circulation over Southeast Asia. Particularly, to examine such features as, the time onset of monsoon and its variability within the season, correlation of the synoptic and meso-structure of cloud systems as revealed over land by satellite and conventional data, and investigate the synoptic time sequence of the winds during the monsoon season, locate principal bad weather areas and their frequency and succession. Author (TAB)

N66-12788# Travelers Research Center, Inc., Hartford, Conn.

A TECHNIQUE FOR ANALYSIS AT 10 MB Final Report, 1 Jan.–31 Jul. 1965

Abraham M. Pavlowitz and Bernard J. Erickson Bedford, Mass., AFSC, Electron. Systems Div., Sep. 1965 76 p refs *Its* Publ. No.-7463-175 Prepared for United Aircraft Corp. Supersedes TM-11-7459-138
(Contract AF 19(628)-3437)
(ESD-TR-65-12; TM-11-7459-138; AD-621940)

Two sets of vertical extrapolation equations were derived to specify initial-guess fields of 10-mb heights and temperatures using a five-year data sample. Both past (t_{-24}) and present (t_0) data were considered as specifiers in the first set of equations. Only present (t_0) data were used as specifiers in the second set of equations. Both sets of equations showed stability when tested on independent data. Further, verification statistics showed that the results from the independent data were similar to those from the dependent data. Both sets of equations were then compared by incorporating them into a modified successive approximation technique to produce initial-guess fields. These initial-guess fields were similar. An experiment comparing the two sets of equations with equations derived by the U.S. Weather Bureau showed that the TRC equations gave lower specification errors. This technical report includes (or supersedes) information previously published under TM 11-7459-138. Author (TAB)

N66-12792# Travelers Research Center, Inc., Hartford, Conn.

CIRCULATION-CLOUD PROGNOSTIC RELATIONSHIPS: SUMMER AND FALL Final Report, 1 Oct. 1964–31 Jul. 1965

Donald A. Chisholm and Gordon B. Lassow Bedford Mass., AFSC, Electron. Systems Div., Sep. 1965 81 p refs *Its* Publ. No.-7463-177 Prepared for United Aircraft Corp.
(Contract AF 19(628)-3437)
(ESD-TR-65-14; AD-621924)

Regression Estimation of Event Probabilities (REEP) equations were derived from summer and fall data samples to diagnose cloud amounts from circulation and moisture prognoses. Equations were derived for total-, low-, middle-, and high cloud amounts, and for the time change of total cloud amount. Sets of equations were derived for 12-, 24-, 36-, and 48-hr forecast intervals. In deriving the equations, persistence and moisture content were found to be the most significant predictors. Of lesser significance were temperature and circulation features (500-mb height, thickness, and vertical velocity). When tested on independent data, the REEP equations gave better results than persistence for each cloud amount category and for each forecast interval. Author (TAB)

N66-12800# Woods Hole Oceanographic Institution, Mass.

THE DYNAMICS OF CUMULUS CONVECTION IN THE TRADES—A COMBINED OBSERVATIONAL AND THEORETICAL STUDY

Joseph Levine (Ph.D. Thesis) Aug. 1965 136 p refs *Its* Rept.-65-43
(Contract Nonr-2196(00); CWB-10693; Grants NSF GP-1451; NSF G-7368)
(AD-621935)

The development and calibration of an aircraft instrument for measuring cloud liquid water and volume median drop diameter is described. A hot wire loop is sensitive to drops smaller than 100 microns. A wire wound around a ceramic cone is sensitive to larger drops. A comparative study of the 'bubble' with the 'steady state jet' model is made and related to tank experiments. A relation of mixing parameters to eddy coefficients is demonstrated. The 'bubble' model is extended to cumulus convection. Formulae for the behavior of average 'bubble' potential temperature, liquid water, and vertical velocity as a function of height are derived. The effects of drop growth by condensation and coalescence and of precipitation are lumped together. A study of cumulus cloud observations is made to compare model computations with observations. Emphasis is placed on the usefulness of the model in parameterizing the statistical properties of clouds. Author (TAB)

N66-12924*# ARACON Geophysics Co., Concord, Mass.
NIMBUS I USERS' CATALOG: AVCS AND APT
Mar. 1965 448 p refs
(Contract NAS5-3253)
(NASA-CR-68190) CFSTI: HC $7.48/MF $2.25 CSCL 04B

The Nimbus I spacecraft carried two television camera systems: the Advanced Vidicon Camera System (AVCS) and the Automatic Picture Transmission (APT) system. The Nimbus I Users' Catalog provides basic documentation required by potential research users of both the AVCS and APT television pictures including such supporting data as daily camera coverage and locations, times, and catalog numbers of the AVCS pictures. The quantity of pictorial data acquired by Nimbus I prohibits publication or general distribution of all available pictures. To assist users in selecting data of greatest probable interest to them, significant meteorological and geographical features identified in the AVCS pictures are noted in the documentation. Background information and terminology, illustrative examples of the AVCS and APT pictures, and procedures for requesting copies of the data are also included.
Author

N66-12983*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
ON THE USE OF INTERMEDIATE INFRARED AND MICROWAVE INFRARED IN WEATHER SATELLITES First Annual Report
Konrad J. K. Buettner, Kristina Katsaros, and William Kreiss Sep. 1965 53 p refs
(Grant NsG-632)
(NASA-CR-68089) CFSTI: HC $3.00/MF $0.50 CSCL 04B

The feasibility of obtaining additional weather information through inclusion of microwave infrared sensors in meteorological satellite payloads was studied. Emissivity or albedo variations in the 4μ window over various terrains of differing surface temperatures were investigated, and field emission measurements obtained by a 10μ window sensor were analyzed and compared to laboratory tests. It was concluded that the top surface of the ground must be free of vegetation or even humus to show any significant deviation from "blackness". Differences in temperature values of some types of terrain were almost entirely due to their individual moisture content; bodies of water showed a high frequency loss in the microwave infrared region. Characteristic radiative temperature curves obtained from evaluation of infrared measurements are shown for different types of ground.
G.G.

N66-13025*# National Aeronautics and Space Administration, Washington, D. C.
UNITARY VERTICAL CONDUCTION CURRENTS AS A MEASURE OF THUNDERSTORM ACTIVITY FOR THE ENTIRE SURFACE OF THE EARTH [UNITARNYY VERTIKAL'NYY TOK PROVODIMOSTI KAK MERA GROZOVOY DEYATEL'NOSTI DLYA VSEY POVERKHNOSTI ZEMLI]
N. A. Paramonov Dec. 1965 13 p refs Transl. into ENGLISH from Meteorol. Issled. (Moscow), no. 9, 1965 p 167–173
(NASA-TT-F-401) CFSTI: HC $1.00/MF $0.50 CSCL 04B

Relationship between the unitary vertical conduction current and the thunderstorm activity for the entire earth's surface was investigated. This relationship proved to be rather close, which is a good reason to consider the unitary vertical conduction current as a criterion of the thunderstorm activity for the entire earth's surface.
Author

N66-13060# Joint Publications Research Service, Washington, D. C.
AEROLOGY IN THE POLAR REGIONS
S. S. Gaygerov 29 Nov. 1965 174 p Transl. into ENGLISH from the book "Aerologiya Polarnykh Rayonov" Moscow, 1964 p 66–90; 92–117; 118–155; 156–230
(JPRS-33068; TT-65-33645) CFSTI: $5.00

A translation of parts of the Russian book on *Aerology in the Polar Regions* is presented as follows: *Certain Features of the Synoptic Processes in the Troposphere of the Arctic and Antarctic; Preliminary Data Concerning Vertical Structure of Cyclones, Anticyclones, and Atmospheric Fronts in the Polar Regions; Thermal and Wind Regime of the Troposphere, Altitude and Temperature of the Tropopause in Polar Regions;* and *The Stratosphere of the Polar Regions.*
E.E.B.

N66-13210# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
METEOROLOGICAL DATA REPORT, ATHENA FLIGHT NO. 031 (11 OCT. 1965)
Len E Carter Nov. 1965 63 p refs
(ERDA-353; AD-473961)

Meteorological data gathered for the launching of Athena flight number 031, vehicle #C-016 are presented for the Air Force ballistic missile reentry systems office and for ballistic studies. The data are presented in tabular form.
Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-12499# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.
AIR TRAFFIC SURVEILLANCE SATELLITES, A MATHEMATICAL MODEL FOR ACCURACY AND COVERAGE Final Report
John J. Kulik Apr. 1965 67 p refs
(RD-65-38)

The theoretical accuracy and coverage of the two most promising air traffic surveillance satellite techniques, a two-satellite multi-rho technique and a single satellite rho-theta-theta technique, are determined by the application of a mathematical model used to derive error isograms for several combinations of satellite positions and range and angle measurement error assumptions. The complete derivation and discussion of the model employed is included, since the model is sufficiently general to apply to a great number of situations involving position determination other than air traffic surveillance. Some conclusions as to the relative merits of the two techniques studied are given, and recommendations are made for future activity.
Author

N66-12902# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
AREA COVERAGE DISPLAYS AND COURSE LINE COMPUTERS EXPERIMENTATION Final Report
G. Adams, D. Brandewie, and R. Harter Oct. 1965 100 p
(RD-65-117)

Pictorial displays and course-line computers, driven by VORTAC receivers, were tested to appraise the value of area navigation in the Air Traffic Control System. Technical and operational aspects were tested in fixed-wing aircraft and by

simulation in the laboratory. This report touches on results from simulation but concentrates on the description of flight tests. From Air Traffic Control simulations, it was concluded that the controller workload may be reduced and his ability to manipulate traffic increased. Flight tests proved that the addition of area displays to VORTAC receivers enhances the usefulness of DME in VORTAC. Off-radial flight accuracies are comparable to the now existing radial accuracies. Author

N66-12905# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
INTERFERENCE PREDICTIONS FOR THE INSTRUMENT LANDING SYSTEM
G. D. Gierhart and M. E. Johnson Sep. 1965 50 p refs
(NBS-TN-324) GPO: $0.30

Co-channel and adjacent-channel interference predictions for the Instrument Landing System are presented in this report. Information on the various types of ground facilities involved is given first. Propagation mechanisms applicable to the 108 to 112 Mc/s frequency range are discussed second together with the calculation of transmission loss and its variability. Third, the statistical treatment of interference problems is explained. Finally, the results of the study are presented as curves of normalized desired-to-undesired signal strength ratios versus distance from the desired station. Aircraft altitudes of 1,000, 6,250, 12,000, and 18,000 feet along with station separations ranging from 20 to 330 nautical miles were considered. Detailed procedures, mathematical formulas, and computer programs used are discussed in the Appendices. Author

N66-12923# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.
EVALUATION OF FIELD APPLICATION OF AN ENROUTE MOSAIC DISPLAY Final Report
Ricardo Cassell Aug. 1965 37 p
(RD-65-105)

An evaluation of the application, and associated operational procedures, of a mosaic radar display was conducted to provide field data pertinent to the application of future mosaic displays. The evaluation consisted of field tests conducted at the Los Angeles Air Route Traffic Control Center (ARTCC), Palmadale, California. Operational tests were conducted in nine low altitude sectors. Evaluation of the display was based primarily on the subjective opinions of Los Angeles ARTCC controller and maintenance personnel and observations by project team members. It was concluded that, while not a true mosaic display, the duo-radar system video display used in tests provided an economical and uncomplicated means of enhancing radar capability through the use of existing equipments. Author

N66-13091*# Philco Corp., Palo Alto, Calif. WDL Div.
INTERPLANETARY NAVIGATION AND GUIDANCE STUDY, VOLUME III: ILLUSTRATIONS AND TABLES
30 Oct. 1965 178 p
(Contract NAS8-11198)
(NASA-CR-68436; WDL-TR-2629, Vol. III) CFSTI: HC $5.00/MF $1.00 CSCL 17G

Illustrations, graphs, and tables referenced in Volume II of the Interplanetary Navigation and Guidance Study are presented. R.N.A.

N66-13155*# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
GIMBALLESS INERTIAL NAVIGATION SYSTEMS Annual Report, 1 Nov. 1964–31 Oct. 1965
Kenneth A. Fegley Nov. 1965 12 p refs *Its* Rept.-66-17
(Grant NGR-39-010-029)
(NASA-CR-68467) CFSTI: HC $1.00/MF $0.50 CSCL 17G

Brief summaries are presented of the research conducted on various phases of gimballess inertial navigation systems. Areas covered include accelerometer techniques for measuring linear and rotational parameters of motion; damping of the navigation loop; the transformation matrix; error analyses; computer simulation, and experimental work. In the experimental studies, two major problems which became apparent were the limitation in the transverse acceleration which the accelerometers can withstand, and the noise generated by the sliding contacts. A list of publications, which give details on the study, is included. M.G.J.

N66-13221# Federal Aviation Agency, Washington, D.C. Navigation Development Div.
INTERFERENCE TO AIRCRAFT CONDUCTING CATEGORY II INSTRUMENT APPROACHES BY OTHER AIRCRAFT IN VICINITY OF THE AIRPORT
Nicholas J. Proferes and Alexander B. Winick Oct. 1965 16 p refs
(RD-65-107)

Investigations were made with regard to possible localizer interference to aircraft conducting approaches to category II minimums (100 feet ceiling — 1/4 mile visibility) by aircraft operating on or about the airport, taking off over the localizer, and aircraft overflying the instrument landing system localizer. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-12266# Battelle-Northwest, Richland, Wash.
METALLURGY RESEARCH OPERATION Quarterly Progress Report, Jan.–Mar. 1965
15 Apr. 1965 58 p refs
(Contract AT(45-1)-1830)
(BNWL-79)

Studies in physical and chemical metallurgy are reported, along with research on reactor metals. Discussed are radiation effects on metals; swelling of irradiated fissionable materials; and the physical metallurgy of plutonium. X-ray diffraction, electron microscopy, metallographic and crystallographic relationships, and phase transformations are considered. Corrosion studies for an ATR gas loop support, and pertinent materials engineering studies for developing gas loops are also discussed. Graphs, tables, and diagrams in support of the various research projects are included. L.S.

N66-12290# Battelle-Northwest, Richland, Wash.
BORON-11 NEUTRON FLUX MONITORS Interim Report

W. L Bunch and M. R. Wood Apr. 1965 19 p refs
(Contract AT(45-1)-1830)
(BNWL-64) CFSTI: $1.00

Several prototype detectors were developed and irradiation tested in efforts to develop a practical neutron flux monitor using B^{11} as the neutron sensitive isotope. Test results showed that suppression of the background signal generated within the cable was necessary before an operational detector could be achieved. To overcome this problem, a parametric evaluation of irradiated coaxial cable signals was undertaken, and qualitative evaluation of background current sources was obtained. Tests, using twin-wire cables, demonstrated that background current can be effectively eliminated without close control of the environment, type of insulation, and sheath and wire dimensions. M.G.J.

N66-12297# Oak Ridge National Lab., Tenn.
NEUTRON PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING AUGUST 1, 1965
J. A. Biggerstaff et al Nov. 1965 79 p refs
(Contract W-7405-ENG-26)
(ORNL-3858, Vol. 1) CFSTI: $3.00

Summaries on work in progress, and abstracts of published papers are presented on the research being conducted by the Neutron Physics Division. Report classifications include: *Nuclear and Reactor Physics, Critical Experiments, Reactor Shielding, Radiation Shielding Information Center, Mathematics and Computer Programs,* and *Radiation Detector Studies.* M.G.J.

N66-12331 Atomics International, Canoga Park, Calif.
ARGON GENERATION IN NaK-COOLED REACTORS
S. L. Rosen 10 Nov. 1965 16 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11303) CFSTI: $1.00

Argon-41, a gamma emitter, was experimentally observed in the primary coolant system of the SNAP-8 experimental reactor. A fast neutron reaction with the potassium-41 in the NaK-78 eutectic alloy coolant is believed to be the mechanism for the generation of the argon-41. This mechanism led to the prediction of the presence of argon-39. This prediction was verified experimentally. Author

N66-12374# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
DETERMINATION OF THE THERMAL NEUTRON FLUX DISTRIBUTION IN A HEXAGONAL LATTICE CELL
Paul Byron Fleming (M.S. Thesis) Aug. 1965 157 p refs
(GNE/PHYS-65-6; AD-621026)

Thermal neutron flux distributions were obtained in hexagonal and square lattice cells by a finite difference approximation to the diffusion equation. The grid network used to approximate the lattice cells was created from a combination of cylindrical and cartesian coordinate systems to facilitate the handling of the normal boundary conditions at the rod surface. Square lattice cell flux distributions for non absorbing media compare favorably to those predicted in analytic solution by Cohen. Marked deviations in this result occur as absorption is increased. Hexagonal and square cell flux distributions agreed within 1.5 per cent to the results predicted by the cylindricalization technique at interior points in the cell for all cases of absorption studied. Large deviations in flux distributions along the cell boundaries indicate that errors may arise in calculations of the thermal utilization based upon the cylindricalization assumption. Deviations in all results near the rod surface are attirbuted to truncation error or normalization technique. Author (TAB)

N66-12478# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
PRODUCTION OF TRANSPLUTONIUM ELEMENTS AT SAVANNAH RIVER
W. P. Overbeck, C. H. Ice, and G. Dessauer [1965] 17 p refs Presented at the Winter Meeting of the Am. Nucl. Soc., Washington, D. C., 15–18 Nov. 1965
(Contract AT(07-2)-1)
(DP-1000) CFSTI: $1.00

The Savannah River Plant has been engaged in two programs for production of transplutonium elements. The first, a research effort, involved the irradiation of plutonium to produce target material for the Oak Ridge HFIR. The second is a production effort to produce 3 kg of ^{244}Cm. These programs have recently been combined in a manner that enhances both, through the use of a new mode of high-flux operation for the Savannah River reactors. Extended irradiation of the HFIR target material has been accomplished in a high-flux test at 5.4×10^{15} neutrons/(cm^2)(sec), and the high-flux mode will be used to accelerate the production of ^{244}Cm. Author

N66-12489# Pratt and Whitney Aircraft, Middletown, Conn.
THERMODYNAMIC PROPERTIES OF URANIUM MONONITRIDE
P. A. Vozzella and M. A. De Crescente 4 Oct. 1965 19 p refs
(Contract AT(30-1)-2789)
(PWAC-479)

A Knudsen effusion apparatus was used to measure the partial pressure of nitrogen over uranium mononitride over the temperature interval 1910° K to 2265° K. A linear least squares fit of these data is given by: $\log_{10}P_{N2}$ (atm) $= 8.279 - 2.874 \times 10^4\ T^{-1}$ where T is in degrees K. The N_2 pressure was found to vary from 1.7 to 3.9×10^{-5} atm over the temperature range 1645° to 1992° C. Based on the decomposition mechanism $UN_{(s)} \rightarrow U_{(l)} + 1/2\ N_{2\ (g)}$ the second law analysis yields a heat of reaction of $H_{2100} = 65.9$ kcal/mole and $S_{2100} = 19.0$ e.u. in the temperature range investigated. The standard heat of formation of $UN_{(s)}$ derived from a third law analysis is $H^\circ_{f\,298} = -74.4 \pm 2.0$ kcal/mole. R.N.A.

N66-12522 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NEUTRON TRANSPORT CALCULATIONS OF THE AIR FORCE NUCLEAR ENGINEERING FACILITY CORE
Donald Lloyd Norman (M.S. Thesis) Aug. 1965 61 p refs
(GNE/PHYS/65-14; AD-621269)

The neutron flux in segments of the core of the Air Force Nuclear Engineering Test Reactor was investigated using transport theory. Two portions of the core were treated: the fuel plates and the control rods. These regions were represented as a one-dimensional array of thin slabs. A matrix collapsing technique for the solution of many region, slab-geometry problems using the P-3 approximation was developed and a computer code to make the calculations was written. It was determined that no flux weighting was necessary in calculating homogeneous cross sections for the fuel regions. A technique was devloped to compute a simplified control rod model, but computing difficulty prevented its being tested. Author (TAB)

N66-12836# Naval Research Lab., Washington, D. C.
IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS, 1 MAY–31 JUL. 1965
L. E. Steele, J. R. Hawthorne, C. Z. Serpan, Jr., H. E. Watson, and E. P. Klier 15 Aug. 1965 49 p refs
(NRL-MR-1638; AD-621867)

The report includes the following: (1) comparative radiation sensitivity of specially prepared heats of A302-B steel, (2) combined effects of temper embrittlement and radiation on Ni–Cr–Mo steels, (3) problems in assessing the notch ductility of a 2-1/4Cr–1Mo Q and T steel, (4) effects of applied stress during irradiation on the notch ductility of A350-LF1(Modified) steel, (5) remote equipment and initial results on tensile properties of several irradiated structural steels, (6) radiation damage surveillance of reactor pressure vessels of the Big Rock Point and the Army SM-1A reactors, and (7) remote machining operations in the NRL High Level Radiation Laboratory. Author (TAB)

N66-12912# General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.
INTERFACIAL REACTION BETWEEN UO_2 AND ZIRCALOY-2
L. N. Grossman and D. M. Rooney Apr. 1965 12 p refs
(Contract AT(04-3)-189)
(GEAP-4679)

The interfacial reaction between UO_2 and Zircaloy-2 has been studied at temperatures between 950 and 1575° K. The reaction proceeds with the formation of oxygen saturated alpha Zircaloy-2 and a gamma uranium-beta zirconium solid solution. The solid solution transforms on cooling to UZr_2 plus some gamma-beta solid solution; some alpha uranium with Zr in solution forms on cooling from the higher temperatures. The interaction between Zircaloy-2 and UO_2 differs from that between Zr and UO_2 principally in the microstructure of the metallic reaction product. The extent of interaction is limited by oxygen diffusion in alpha Zircaloy-2; the oxygen diffusion rates are essentially identical to those in alpha zirconium. Author

N66-12921# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
HIGH-TEMPERATURE GRAPHITE IRRADIATIONS: 800 TO 1200°C Interim Report No. 1
J. W. Helm Sep. 1965 70 p refs
(Contract AT(45-1)-1830)
(BNWL-112) CFSTI: $3.00

Temperature monitored irradiation test was conducted to determine the behavior of several types of graphite at high temperatures and neutron exposures. The graphites irradiated were: convectional-coke, needle-coke, and raw-coke graphites. The physical distortion of the graphites tested showed a dependence on the temperature of irradiation, although this varied considerably for the various graphites. R.C.S.

N66-12938# Battelle-Northwest, Richland, Wash.
RESEARCH AND DEVELOPMENT ACTIVITIES, FIXATION OF RADIOACTIVE RESIDUES Quarterly Progress Report, Apr.–Jun. 1965
A. M. Platt, ed. Sep. 1965 36 p
(Contract AT(45-1)-1830)
(BNWL-139) CFSTI: $2.00

Phosphate glass samples produced from Purex waste have not changed in leachability since they were made but are showing evidence of separation of a minute second phase. Glass formulation studies indicate that the glass properties are affected by the precious metal and fission product contents of the glasses. Flowsheet development with simulated NFS 1st and 2nd cycle waste and added phosphoric acid was completed with a successful 40-hour spray calciner run. Metallic cation equivalent to phosphorous atom ratio (M^+/P) equal to 3.1 was the most successful composition. A sulfate bearing condensate feed adjusted to melt with caustic was not operable in the spray calciner melter. Other tests included successful thermal shock cleaning of the calciner wall, an acceptable air vibrator to replace an air hammer, and wire filters. Fabrication of the spray calciner system for Waste Solidification Engineering Prototypes (WSEP) is complete. Design verification testing of the pot calciner prototype and its related WSEP hardware was completed. Fission release tests were made with 15 g samples of simulated waste material spiked with Cs^{137}. Release fractions of up to 1% were observed during 1 hour at temperatures up to 1200° C. R.N.A.

N66-13001# Los Alamos Scientific Lab., N. Mex.
IODINE-131 SAMPLING WITH ACTIVATED CHARCOAL AND CHARCOAL-IMPREGNATED FILTER PAPER
H. J. Ettinger and J. E. Dummer, Jr. 9 Nov. 1965 19 p refs
(Contract W-7405-ENG-36)
(LA-3363) CFSTI: $1.00

Samples of stack effluent from an operating reactor, and from a hot cell complex in which spent reactor fuel elements are examined, showed activated charcoal efficiencies ranging from 70%–99%, with a median efficiency of 90%. Three different charcoal-impregnated filter papers were unsatisfactory for monitoring radioiodine because their collection efficiencies varied widely. Both impregnated filter papers and activated charcoal cartridges were tested at various sampling velocities. The effect of methyl chloroform on the iodine collection efficiency of activated charcoal was evaluated. The collection efficiencies of charcoal cartridges soaked in methyl chloroform ranged from 72%–90%, with a median of 81%. Concurrent sampling with charcoal cartridges not treated with methyl chloroform showed an efficiency range of 71%–95%, with a median of 86%. Field tests indicate the need for carefully considering the iodine collection efficiency of activated charcoal for air cleaning systems and respirators. Author

N66-13034# Pratt and Whitney Aircraft, Middletown, Conn. Canel Div.
INTERACTIONS IN A TYPE 316 STAINLESS STEEL-NaK-Cb-1 Zr ALLOY SYSTEM
C. J. Lymperes, J. D. Chapman, and G. F. Schenck [1965] 23 p
(Contract AT(30-1)-2789)
(TIM-896)

A forced circulation type 316 stainless steel corrosion loop was operated isothermally at 1250° F with NaK and Cb–1Zr alloy specimens for 3094 hours to study the kinetics of the interaction of the Cb–1Zr alloy with carbon, nitrogen, and oxygen in the stainless steel/alkali metal system. Results showed that a carbide/nitride surface reaction layer formed within 250 hours and grew to a maximum thickness of 0.0001 inch in 1000 hours. Carbon contamination which occurred during the test remained isolated near the surface. Nitrogen contamination which occurred throughout the test diffused to a depth of at least 0.010 inch. There was no significant oxygen contamination, and no significant difference between the behavior of specimens in the low velocity flow surge tank and those exposed to a higher flow velocity. R.N.A.

N66-13043# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
EXTRUSION OF CLAD AND UNCLAD YTTRIUM FOR ROD AND TUBING

C. V. Owen, T. E. Scott, and O. N. Carlson Aug. 1965 18 p refs
(Contract W-7405-ENG-82)
(IS-1031)

The extrusion of yttrium metal into rods and seamless tubing was studied. Extrusions were made using both as arc-cast and recrystallized starting billets. The results of these extrusions are discussed and criteria for obtaining good tubing are suggested. Author

N66-13092*# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
INVESTIGATION OF EXPLOSIONS IN IRRADIATED LIQUID-NITROGEN DEWARS
J. Romanko 15 Dec. 1964 122 p refs Prepared for NASA
(Contract AF 29(601)-6213)
(NASA-CR-68435; FZK-219) CFSTI: HC $4.00/MF $1.00 CSCL 18I

Investigations were conducted on the phenomena occurring before, during, and after explosions involving irradiated dewars of liquid nitrogen with various amounts of impurities, including oxygen, water vapor from the ambient air, and solid catalysts, to determine the cause of explosions in cryogen test vessels used in nuclear reactor experiments. The first part of the study involved producing explosions under controlled conditions in specially designed open and closed dewars outfitted with various diagnostic instruments, and identifying the conditions under which the explosions occur. However, this study was terminated before sufficient data could be obtained. The second part involved fundamental experiments using spectrometric instruments to determine the processes leading to explosions. Spectrographic studies were conducted using a common dewar to obtain information on reactions occurring during the explosions. Electron paramagnetic resonance experiments were conducted on samples of irradiated impure liquid nitrogen subsequently investigated for paramagnetic species as a function of irradiation dose, to determine reactions occurring before explosions. R.N.A.

N66-13110# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR).
STUDY OF U-235 Be SUBCRITICAL ASSEMBLIES BY THE PULSE METHOD [IZUCHENIE U^{235} + Be PODKRITICHESKIKH SBOROK IMPUL'SNYM METODOM]
I. F. Zhezherun 1965 28 p refs In RUSSIAN
(IAE-844) CFSTI: HC $1.00/MF $0.50

Subcritical assemblies are studied for U-235 with beryllium control rods. Pulse method is used, and the apparatus is diagrammed. Results are presented in both graphic and tabular form. Transl. by M.W.R.

N66-13124*# Aerojet-General Corp., Sacramento, Calif. Sacramento Plant.
DESIGN SPECIFICATION ENGINE, ROCKET, NUCLEAR, XE-1, NERVA PROGRAM
E. Landesberg Mar. 1965 38 p Supersedes RN-DR-0020
(Contract SNP-1)
(NASA-CR-68622; AGC-90016; RN-DR-0020) CFSTI: HC $2.00/MF $0.50 CSCL 21F

Design specifications are given for the hot-bleed, shielded, XE-1 configuration of the ground test experimental version of the NERVA engine series. This engine is suitable for static firing tests (300 sec max) with the engine oriented in a nozzle-down position. Specifications are given for the following major subsystems: reactor and thrust chamber assemblies; external shield; and propellant feed, emergency cooldown, pneumatic, control, and diagnostic instrumentation systems. C.T.C.

N66-13125*# Aerojet-General Corp., Sacramento, Calif. Rocket Engine Operations.
[STUDIES OF THE NERVA PROGRAM] Third Quarterly Report, Apr.–Jun. 1965
30 Sep. 1965 298 p refs *Its* Informal Progress Letter No. 36
(Contract SNP-1)
(NASA-CR-68623; RN-Q-0036) CFSTI: HC $6.00/MF $1.50 CSCL 21F

Progress in the NERVA engine development program and its associated tasks is reported. The material is presented in a precise summary manner, and includes developments in the following areas: engine system, propellant feed system, reactor system integration, thrust chamber assembly, engine controls, systems analysis, radiation effects program, remote handling equipment, ground support equipment, instrumentation, ground operations safety, product assurance, non-fuel materials, and exhaust system. C.T.C.

N66-13133# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
LEAK TESTING OF THE HWCTR CONTAINMENT BUILDING
S. H. Kale, E. O. Kiger, T. C. Gorrel, and L. M. Arnett Oct. 1965 41 p refs
(Contract AT(07-2)-1)
(DP-968) CFSTI: $2.00

Special techniques were developed to measure the total leak rate from the containment building and to determine the location of small leaks. The containment structure was a composite steel and prestressed reinforced concrete building. The series of tests conducted showed that the leak tightness of the building initially decreased with time. The periodic tests that are described permitted leaks to be found and repaired, so that the leakage was maintained at an acceptably low value. Author

N66-13142# Atomics International, Canoga Park, Calif.
CAPABILITIES OF THE 1Mw SHIELD TEST AND IRRADIATION REACTOR
K. G. Golliher and K. G. Randen 10 Nov. 1965 23 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-11528) CFSTI: $2.00

The physical layout of the facility is described, and the results of measurements of the neutron fluxes and gamma ray dose rates are mentioned. Integrated neutron flux and gamma dose values are summarized for 8 hours of 1-megawatt reactor operation. Areas in the facility described are the operations building, the reactor room, the test vault, and the laboratory. Also mentioned are: (1) reactor complex; (2) radiation testing—incore and inpool irradiations, irradiation thimbles, and test vault irradiations; and (3) some typical experiments—lithium hydride setup, exterior of STIR(shield test and irradiation reactor) collimator, internals of vacuum capsule, and water tank for neutron age experiments. R.W.H.

N66-13186# Atomics International, Canoga Park, Calif.
AEC UNCLASSIFIED PROGRAMS Annual Technical Progress Report, Fiscal Year 1965
10 Nov. 1965 418 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11450) CFSTI: $7.00

Objectives, technical progress, and project evaluations are presented for various atomic energy reserch programs. Summarized reports cover such areas as sodium-reactor experiments; large sodium–graphite reactors; fast-reactor, and sodium components development; sodium-cooled reactor advanced development; HNPF–PNPF fuels; and reactor technology, safety, and research. M.G.J.

N66-13195# Japan Atomic Energy Research Inst., Tokyo.
STUDIES ON Al–U ALLOYS
Noritsugu Mitamura, Kazuo Maruya, and Jotaro Kimura Jan. 1965 22 p refs Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), v. 5, no. 6, Jun. 1963 p 467–475 (NSJ-TR-6) CFSTI: HC $1.00/MF $0.50

Al-U alloy is one of the typical dispersion fuels which are now being used in high performance research reactors. Due to a large fraction of intermetallic compound, Al-U alloy containing 40 wt % U is inherently brittle and difficult to fabricate. Microstructures of castings, and the effect of some additives in 45 wt % U-Al alloy were investigated using optical and electron microscopes and an X-ray diffractometer. Reduction of UF_4 with pure molten aluminum succeeded with a yield better than 94%. Diffusion coefficient measurements of uranium in molten aluminum gave the following equation:

$$\log D\ (cm^2\ sec^{-1}) = -3.450 + -(0.103 \times 10^4)/T$$

Because of the small diffusion coefficient of uranium, reduction processes with aluminum were considered superior to ordinary melting processes in fabricating these alloys containing close to 30 wt % U. Author

N66-13214# Naval Ordnance Lab., White Oak, Md.
ON THE SCALING OF PRESSURES FROM NUCLEAR EXPLOSIONS WITH SOME OBSERVATIONS ON THE VALIDITY OF THE POINT-SOURCE SOLUTION
Morton Lutzky and Delbert L. Lehto Nov. 1965 19 p refs (NOLTR-65-74; AD-473711)

This report discusses the scaling of pressure-distance curves for a particular model of a nuclear explosion using an ideal-gas equation of state. A family of non-dimensional curves is presented which allows scaling to different ambient conditions for a given energy source. These curves also make possible scaling close-in to the initial fireball. In addition, it is shown that the theoretical point-source solution for an ideal gas agrees with the computed solutions, except at close-in distances and at shock strengths below 50. It is shown that neither of these ideal-gas solutions agrees as well with experiment as does a real-gas solution. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N66-12159*# Ling-Temco-Vought, Inc., Dallas, Tex. Research Center.
INVESTIGATIONS OF ELECTRON INTERACTIONS WITH MATTER. PART 1: BREMSSTRAHLUNG PRODUCTION IN ALUMINUM AND IRON. PART 2: ELECTRON SCATTERING IN ALUMINUM
William E. Dance, Leo L. Baggerly, David H. Rester, and Walter J. Rainwater, Jr. Washington, NASA, Dec. 1965 93 p refs (Contract NASw-948)
(NASA-CR-334) CFSTI: HC $3.00/MF $0.75 CSCL 20H

Bremsstrahlung measurements from spectral and angular electron distributions are reported for targets of aluminum and iron in the electron energy range 0.5 MeV to 3.0 MeV. In all cases the intensity spectra were smoothly decreasing functions of the photon energy. The experimental uncertainty in the absolute value of the presented intensities was estimated to be ±20%. Thin aluminum target differential cross sections for 0.5 MeV and 1.0 MeV electrons and photon emission angles 15, 20, and 30 degree were obtained for three thicknesses. Comparison of the 1.0 MeV differential cross sections with the Bethe–Heitler theoretical values indicate that this theory underestimates the cross sections over most of the 15 degree spectrum, and also over a portion of the 30 degree curve. Measurements of electron scattering from thin aluminum foils and of electron penetration through aluminum slabs were compared to calculated Moss cross sections, and to electron energy distributions as calculated by the Monte Carlo method, respectively. The largest value of momentum transfer for electron scattering occurred at an incident energy of 3 MeV and a scattering angle of 150 deg. G.G.

N66-12163*# Radio Corp. of America, Princeton, N. J.
ADSORPTION OF CESIUM ON INSULATORS
Jules D. Levine Washington, NASA, Dec. 1965 39 p refs (Contract NAS3-4173)
(NASA-CR-349) CFSTI: HC $2.00/MF $0.50 CSCL 20J

This study was conducted to fully understand the system of cesium adsorption on insulators. The ground state wave function of a cesium atom on a dielectric surface is theoretically determined to be one lobe of a 2p hydrogenic wave function penetrating deep into the dielectric, and general rules for selecting surface wave functions of all excited states and arbitrary surface asymmetry were derived. Cesium–cesium interactions are calculated using Kopineck's resonance integral between neighboring wave functions. Conductivity proceeds via cesium–cesium electron tunneling and the conductivity relation is derived in terms of Kopineck's integral and the surface phonon transitions which supply the conductivity loss mechanism. Phonon energies are calculated from the vibrational motion of surface atoms. Conductivity varies as the cesium coverage squared, to a first approximation. An equation of state is derived showing the linear dependence of coverage and arrival rate for the low coverage system. Conductivity is predicted to be proportional to the cesium pressure squared. This prediction is verified experimentally. R.N.A.

N66-12267# Brookhaven National Lab., Upton, N. Y.
INTERSTITIAL REACTIONS IN GRAPHITE DURING NEUTRON REIRRADIATIONS. I: STEADY STATE CONSECUTIVE REACTIONS
Donald G. Schweitzer [1964] 14 p refs
(Contract AT(30-2)-GEN-16)
(BNL-8222)

Property changes in alternately irradiated and annealed graphite are explained by postulating the existence of consecutive reactions between mobile and immobile interstitials during reirradiations. Saturation in dimensional and stored energy changes is interpreted as evidence for steady-state concentrations of various interstitial entities. The removal of radiation damage by the technique of alternate irradiations and anneals is shown to be consistent with the solution of the kinetic equations for the postulated reactions. Author (NSA)

N66-12281# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON A CASE OF INTEGRABILITY OF THE EQUATIONS OF PERTURBED SATELLITE MOTION
K. G. Valeev 3 Oct. 1964 2 p ref Transl. into ENGLISH from PMM, (Leningrad), v. 29, no. 4, 1965 p 751

The case of satellite motion under the effect of Newtonian forces, and an additional perturbing force directed perpendicularly to the motion velocity and in the trajectory plane, is considered. The motion equations are integrated in quadratures if the magnitude of the force depends only on the velocity and the distance of the satellite to the attracting center. Author

N66-12320# Unified Science Associates, Inc., Pasadena, Calif.
STUDY OF IONIZATION POTENTIAL OF SMALL PARTICLES Final Report, 16 Jul. 1964–15 Jul. 1965
Keung P. Luke and Sam Naiditch Oct. 1965 91 p refs
(Contract AF 19(628)-4168)
(AFCRL-65-815; AD-622276)

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N66-12321 Unified Science Associates, Inc., Pasadena, Calif.
EVALUATION OF A KINGDON CAGE ION DETECTOR USING A DIRECTLY-HEATED EQUIPOTENTIAL CATHODE
Keung P. Luke, R. A. Williams, and Sam Naiditch *In its* Study of Ionization Potential of Small Particles Oct. 1965 2 p (See N66-12320 03-23)

A space-charge limited diode (Kingdon cage) was used to detect positive particle ions from the photoelectric effect of ejected electrons in order to determine the electron work function of small particles. The current voltage characteristics of this cylindrical diode, with the cathode filament directly heated by square wave current, were studied by the following methods: (1) Positive ions of He, N_2, and Hg were generated outside the diode and the change in output current was measured as a function of the anode voltage, the cathode temperature, and the bombardment energy used in producing the ions. It was found, that the detector's sensitivity to positive ions depended strongly on the cathode temperature and the cathode to anode voltage, and that the square-wave heating technique is useful for measuring the ionization of gas molecules. The second method used a monochromatic light beam to produce ionizing cesium atoms in the cathode to anode region of the detector. The detector output was then measured as the wavelength of the monochromatic light was varied from 2300 Å to 3800 Å. Detector response curves showed good agreement with photoionization cross section curves for cesium vapor. G.G.

N66-12322 Unified Science Associates, Inc., Pasadena, Calif.
COMMENTS ON THE WORK FUNCTION OF METAL DROPLETS
Keung P. Luke *In its* Study of Ionization Potential of Small Particles Oct. 1965 6 p refs (See N66-12320 03-23)

The theoretical work function of a metallic particles as a function of its size was re-examined. Two established, slightly different, but equivalent expressions for work required to remove an electron from a metal droplet were reviewed, and a more complete expression for calculating the energy was obtained by formula: $\phi_1 = \phi_0 + (W_1 - W_0) - (E_{F1} - E_{F0})$ where the electron work function of a metal ϕ is $\phi = W - E_F$, in which W is the image energy and E_F is the Fermi energy. The possible contribution of the term $(E_{F1} - E_{F0})$ expressing the effect of dispersion of the Fermi energy of a metal was then used to form a simple model for an electron gas in a three dimensional potential box for metal. Example calculations on a neutral potassium droplet established the value of $(W - e\phi_W)$ as $-0.09(e^2/r_d)$, where $e\phi_w$ is the flat surface work function, and r_d is the droplet radius. G.G.

N66-12323 Unified Science Associates, Inc., Pasadena, Calif.
CONTRIBUTION TO THE THEORY OF AEROSOL FORMATION IN AN INERT GAS ATMOSPHERE. PRENUCLEATION KINETICS
Keung P. Luke *In its* Study of Ionization Potential of Small Particles Oct. 1965 17 p refs (See N66-12320 03-23)

The kinetics of aerosol formation in an inert gas atmosphere may be considered as proceeding in the following steps; pre-nucleation, nucleation, growth and coagulation. In this paper the pre-nucleation kinetics or the cooling-down process of a hot vapor in the presence of a cooler inert gas is examined using the model that the cooling mechanism is the elastic collision process between vapor and gas atoms. Computed values of average energy loss per collision, asymptotic time constant for the cooling-down process, and the time required for cooling a vapor from 1800° K to 900° K and 450° K, respectively, are presented for sixteen different vapor-gas pairs. Our results are consistent with the conclusion of Kerker et al that the rate of energy transfer from a body of hot NaCl vapor to a cooler helium gas is extremely rapid. Author

N66-12359# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UKRAINIAN JOURNAL OF PHYSICS Selected Articles
15 Jun. 1965 31 p refs Transl. into ENGLISH from Ukr. Khim. Zhur. (Kiev), vol. 9, no. 7, 1964 p 733–743, 766–768
(FTD-TT-65-233/1+2+4; AD-621005)

CONTENTS:

1. INVESTIGATING RECOMBINATIONS ON NICKEL ATOMS IN p-GERMANIUM AT HIGH INJECTION LEVELS A. P. Klimenko and Yu. O. Tkhorik p 1–20 refs (See N66-12360 03-26)

2. HIGH TEMPERATURE ULTRASONIC INTERFEROMETER P. M. Vyugov and V. S. Gumenyuk p 22–26 refs (See N66-12361 03-23)

N66-12361 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH TEMPERATURE ULTRASONIC INTERFEROMETER
P. M Vyugov and V. S. Gumenyuk *In its* Ukr. J. of Phys. 15 Jun. 1965 p 22–26 refs (See N66-12359 03-01)

An ultrasonic interferometer for measuring the rate of sound propagation in diluted metals and alloys at high temperature is described. Also, the speed of sound in liquid aluminum was measured with the interferometer at 750° C. It was found that the speed of sound was several percentages smaller in the liquid than in solid aluminum metal. E.E.B.

N66-12443# Joint Publications Research Service, Washington, D. C.
COMBATING NOISE AND SONIC VIBRATION ON SHIPS
N. R. Chetyrkin 2 Dec. 1965 5 p Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 5, May 1962 p 74
(JPRS-33129; TT-65-33705) CFSTI: $1.00

In this book review, a favorable report is given on the scientific and technical level of the material presented on the fundamentals of physical and physiological acoustics; acoustical measurement techniques; insulating material for sonic and vibration insulation, and vibration absorption; sound isolation and sound absorption; various designs of sound absorbers and silencers; resonant vibration absorbing systems; and the silencing of marine mechanisms and equipment at the source. Mention is also made of the illustrations, and the numerical examples which facilitate use of the material. M.G.J.

N66-12490# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MONTHLY REPORTS OF THE ACADEMY OF SCIENCES IN BERLIN Selected Articles
11 Jun. 1965 11 p refs Transl. into ENGLISH from Akad. der Wiss., Monatsberichte (Berlin), v. 6, no. 3, 1964 p 166–171, 238
(FTD-TT-65-226/1+2+4; AD-470332)

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1. THE MEASUREMENT OF THE v X B BEHIND MAGNETOHYDRODYNAMIC SHOCK WAVES IN THE TRANSVERSE MAGNETIC FIELD L. Rothhardt p 1–7 refs (See N66-12491 03-25)

2. THE DEPENDENCE OF THE MAGNETIC-FIELD INDUCED ANISOTROPY IN NICKEL–IRON FERRITES ON THE NICKEL CONCENTRATION K. Motzke p 8 (See N66-12492 03-26)

N66-12493# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
ULTRAHIGH VACUUM TECHNIQUES Quarterly Progress Report, 1 Jul.–30 Sep. 1964
W. J. Lange and J. H. Singleton [1964] 9 p refs
(Contract AT(30-1)-2823)
(WERL-15; RR-64-9E1-441-R-2)

Thermal desorption data for the α-phase of carbon monoxide on tungsten are now available for a wide pressure and temperature range. The data have been used to define a tungsten surface having negligible α-phase carbon monoxide coverage, but with no depletion of the tightly bound β-phases for the study of photodesorption. The probabilities obtained, $\sim 2 \times 10^{-7}$ and $\sim 2 \times 10^{-6}$ molecules desorbed per photon, at 3000 and 2100 Å respectively are appreciably higher than those obtained for photodesorption from quartz, pyrex or nickel. The study of the interaction of oxygen with heated tungsten was completed for the range $10^{-5} - 10^{-8}$ Torr and 1200–2500° K. Estimates are made of the efficiency of removal of carbon impurities from tungsten by the process of heating in oxygen. NSA

N66-12525# Holman (John F.) and Co., Inc., Washington, D.C.
THEORETICAL STUDY OF THE SCATTERING OF LIGHT BY A FLUID DISPLAYING A SINGLE AXIS OF ISOTROPY: APPLICATION TO NEMATIC-TYPE LIQUID CRYSTALS [ETUDE THEORIQUE DE LA DIFFUSION DE LA LUMIERE PAR UN FLUIDE PRESENTANT UN SEUL AXE D'ISOTROPIE: APPLICATION AUX CRISTAUX LIQUIDES DU TYPE NEMATIQUE]
Pierre Chatelain Fort Belvoir, Va., Army Engr. Res. and Develop. Labs., Oct. 1965 15 p refs Transl. into ENGLISH from Acta Cryst. (Copenhagen), v. 4, 1951 p 453–457
(Contract DA-44-009-AMC-930-(T))
(ERDL-T-1804; AD-621938)

A theoretical study is made of the diffusion of light by a liquid composed of anisotropic particles which show fluctuations in orientation and are so distributed that the medium possesses a unique isotropic axis. Two cases are considered: (1) discrete anisotropic molecules; (2) large groups of parallel anisotropic molecules dispersed among isolated molecules. In the two cases the theory leads to depolarization factors greatly in excess of unity. Spherical groups, of radius 0.1 microns, containing 1 000 000 molecules of azoxy-anisole arranged parallel and inclined at an angle < 36 deg to the isotropic axis and single molecules inclined at an angle > 36 deg are discussed in detail, and the results obtained agree in order to magnitude with experiment. It can, therefore, be concluded that in nematic liquid crystals diffusion is due to fluctuations in the orientation of the molecules round the isotropic axis and that the fluctuations in two molecules can be treated as independent only if their separation exceeds 0.1 microns.
Author (TAB)

N66-12528*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEPENDENCE OF ADSORPTION PROPERTIES ON SURFACE STRUCTURE FOR BODY-CENTERED-CUBIC SUBSTRATES
Robert J. Bacigalupi and Harold E. Neustadter Washington, NASA, Dec. 1965 24 p refs
(NASA-TN-D-3141) CFSTI: HC $1.00/MF $0.50 CSCL 20

The Lennard–Jones 6–12 atom interaction potential is applied to the calculation of adsorption energy of an atom onto as many as 132 sites on a unit cell area of each of the eight highest surface density planes of a body-centered-cubic substrate. From the calculations, topographical maps of adsorption energy on a unit cell area of each plane for various adsorbate-adsorbent combinations are plotted. Normalized values of maximum adsorption energies and minimum surface diffusion activation energies for all cases are tabulated. The results are compared with available experimental data concerning adsorption of alkali metals, alkali earth metals, and inert gases on transition metal substrates and are in good agreement. Application of the results to transition-metal–transition-metal combination predicts that the 110 surface is the lowest energy configuration for a body-centered-cubic crystal. Author

N66-12574# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
FREE NONLINEAR DYNAMICS OF A ROTATING FLEXIBLY-CONNECTED DOUBLE-MASS SPACE STATION
Fred Austin Jan. 1965 48 p refs
(ADR-06-15-64.1)

Exact solutions to the dynamic equations for a free rotating flexibly-connected double-mass system have been investigated to ascertain the nonlinear effects on the system dynamics. The results are expressed in terms of the canonical forms of elliptic integrals. Numerical results illustrate the radial vibration wave form and the frequency variation with rotational speed. The nonlinear effects become pronounced in systems where the ratio of the rotational speed to non-rotating flexible-body frequency is high; however for practical space-station applications the character of the results can be closely predicted by the application of linearized solutions for oscillations as high as ten percent of the radius. Author

N66-12605# Naval Ordnance Test Station, China Lake, Calif.
RELIABILITY CONCEPTS IN THE HERO PROGRAM
Russell N. Skeeters Aug. 1965 8 p ref
(NOTS-TP-3895; NAVWEPS-8794; AD-620984)

The report examines the basic philosophy, general objectives, and definition of tasks of the HERO program. It is believed that efforts to solve the HERO problem have been stultified by adherence to a doctrine of absolutism in which HERO has been regarded more as a safety program than a means for contributing to the Navy's mission. The report emphasizes the importance of reliability concepts for the stated objectives, and proposes a breakdown of the general problem into four phases, together with a realignment of responsibilities based on this division. Author (TAB)

N66-12641# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE EQUILIBRIUM AND TENSION FIGURE OF A FLEXIBLE THREAD UNDER THE EFFECT OF OUTER FORCES, DEPENDING UPON THE DIRECTION OF THE THREAD IN SPACE
N. I. Alekseyev 20 Aug. 1965 7 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, no. 5, 1964 p 949–951
(FTD-TT-65-676/1+4; AD-620775)

A general solution to the problem for concrete fields of outer forces is presented, with Descartes coordinates used to explain spatial and plane cases of thread disposition. Equilibrium equations are formulated for a flexible nonstretching homogeneous thread. A system of coordinates was selected so that the direction of one axis of the coordinates coincided with the direction of homogeneous field forces. M.G.J.

N66-12643# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
TEXAS BIANNUAL OF ELECTRONICS RESEARCH, NO. 1 Progress Report, Oct. 1, 1964–Mar. 31, 1965
Arwin A. Dougal 15 May 1965 167 p refs
(Grant AF-AFOSR-766-65)
(AFOSR-65-1715; AD-620913)

Research topics in progress, recent findings, and future plans in the areas of biomedical electronics; information sciences; physical, quantum, and plasma electronics; and space, atmospheric, and earth radio sciences are presented. TAB

N66-12763# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL GENERATION OF AN ELECTRON BEAM BY A HOLLOW COLD CATHODE
V. A. Zrazhevskiy 1 Jun. 1965 6 p Transl. into ENGLISH from Avt. Svarka (Kiev), no. 7, 1964 p 91–92
(FTD-TT-65-164/1+2; AD-620121)

Electron beams produced by a hollow cold cathode with perforated walls are considered. The cathode is made of a grid in the form of a hollow cylinder or sphere and has an opening through which the beam is directed. The discharge occurs through the cathode as a result of its being bombarded by positive ions and photoemission by soft X-ray radiation. The field of the anode is distorted by the cathode aperture, which forms a focusing lens and brings out the electron beam. A brief discussion of this method applied to electronic welding is included. C.T.C.

N66-12786# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMBINED OSCILLATIONS OF WORK VANES AND DISCS IN A TURBODYNAMO
S. I. Bogomolov 18 Jun. 1965 19 p refs Transl. into ENGLIGH from Energomashinostr. (Moscow), no. 2, 1965 p 7–11
(FTD-TT-65-580/1+2+4; AD-620951)

This article presents a method for calculating the frequency and form of the simultaneous oscillations of the working vanes and discs of a turbodynamo taking into account all of the basic factors which have an effect on their oscillation, and certain computational results are carried out using the M-20 computer. TAB

N66-12828# Naval Research Lab., Washington, D. C.
A REVIEW OF WORLD CONTRIBUTIONS FROM 1945 TO 1965 TO THE THEORY OF ACOUSTIC RADIATION. CHAPTER II: THREE-DIMENSIONAL HARMONIC RADIATION
S. Hanish 6 Aug. 1965 120 p refs
(NRL-MR-1636; AD-621125)

Contents: the n'th Order Spherical Radiator; Acoustic Intensity and Acoustic Power of Spherical Radiators; Radiative Capacity of the n'th Order Spherical Radiator; Increment of Mass and Accession of Inertia For Spherical Radiators; Near Field and Far Field of Spherical Radiators; Acoustic Power from Point Sources—from One Spherical Cap—From Two Spherical Caps of Opposing Velocity at the Poles of a Spherical Radiator; Acoustic Radiator From a Zonal Radiator on a Spherical Baffle; The Spheroidal Wave Field; Zonal Radiators on Spheroids; The Radiation of Sound in the Limit of High Frequencies—The Geometric Case; The Radiation of Sound in the Limit of High Frequencies: the Geometric Case Plus Terms of Higher Order; Radiation From a Surface of Revolution, Numerical Procedure of Chertock; Calculation of the Radiation of Sound From a Surface of Revolution By the Method of Copley; Empirical Analysis of 3-Dimensional Steady State Fields by the Method of Pachner. TAB

N66-12878# Michigan Univ., Ann Arbor. Acoustics and Seismics Lab.
EXPERIMENTAL STUDY OF SOUND POWER RADIATED FROM COLD MODEL JETS AND GROUND SILENCING ARRANGEMENTS, VOLUME I Technical Report, Dec. 1962–Jul. 1964
Norman E. Barnett 1965 218 p refs *Its* Rept.-05478-6-F
(Contract AF 33(657)-8802)
(AFAPL-TR-65-55, Vol. I; AD-621634)

An experimental and exploratory study of radiated sound power has been conducted with cold model jets and various additions to those jets. The objective was to provide insight into the physical acoustical problems related to the design of ground runup silencers for use with advanced jet aircraft. The results demonstrate the complexity of this silencing problem and indicate how the radiated sound power from a given jet can be increased or decreased through several orders of magnitude. The results indicate that various features common to current muffler hardware must act to increase rather than decrease noise with consequent limitation to the silencing obtainable. Further results suggest how to proceed more directly with silencing. A complete exploration of methods and parameters has not been possible and thus additional research is needed to yield all of the insight that can be provided by study of model jets. Author (TAB)

N66-12910# Lockheed Missiles and Space Co., Sunnyvale, Calif.

DENSITY DISTRIBUTION OF INTENSE RADIATION IN AN ABSORBING SAMPLE

F. K. Rutkovskii and V. P. Gribkovskii [1965] 6 p refs Transl. into ENGLISH from Zh. Prikl. Spektral'n. (USSR), v. 3, no. 1, Jul. 1965 p 32–37

An expression was obtained for the computation of the space density of light energy in an absorbing sample of arbitrary geometric shape taking into consideration the clearing up of the substance under the effect of powerful exciting radiation. Numerical computations are performed and the condition for uniform energy distribution in a cylindrical rod is found. R.N.A.

N66-12929*# Advanced Technology Labs., Mountain View, Calif.

RESEARCH ON DIFFUSION OF HYDROGEN THROUGH PALLADIUM–SILVER ALLOY, PHASE 3 Final Report, Apr. 1964–May 1965

R. C. Bachmann 31 May 1965 96 p refs

(Contract NAS7-118)

(NASA-CR-68185; ATL-D-1306) CFSTI: HC $3.00/MF $0.75 CSCL 20

The characteristics of hydrogen diffusion through palladium–silver alloy tubing at temperatures between ambient and 700° F were established. Measured flow rate trends indicate repeatability, and a relationship was derived that can be used to predict these trends. No variation in hydrogen flow rates was detected between annealed and unannealed elements. However, a significant dependency of physical properties upon the degree of element annealing was evidence. Methods to insure element decontamination were devised and their effect has proved permanent. Analytical studies based on experimental results showed that the use of the hydrogen diffusion valve principle with an appropriate thruster configuration can produce and sustain micropound thrust levels requiring a minimum power input. Results indicate that a thruster containing a 40-inch diffusion element at an element temperature of 350° F could produce a 100-micropound thrust with a power input requirement of 3 watts. The measured dynamic range (flow rate) of such a device is 10^3. R.N.A.

N66-12962*# IIT Research Inst., Chicago, Ill.

INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Quarterly Report, 1 Aug.–1 Nov. 1965

G. A. Zerlaut, B. H. Kaye, and M. R. Jackson 9 Nov. 1965 58 p refs

(Contract NASr-65(07))

(NASA-CR-68299; IITRI-U6003-16) CFSTI: HC $3.00/MF $0.50 CSCL 20F

This report is concerned primarily with simulated systems using random-number techniques. Experiments with randomly superimposed screens were performed. Data show that the predicted and measured straight-through fractional areas agree within the limits imposed by experimental error and statistical fluctuations. The use of Monte Carlo simulation techniques resulted in the deduction of a Lambert–Beer equation for the attenuation of light in a pigmented system. A Monte Carlo plotting experiment showed that at 17% pigment by volume, there is an absolute maximum of scattering centers and that farther additions of pigment only serve to create larger clusters. Similarly, the Monte Carlo plotting technique was used to explore the possible role of extender pigment in a paint film. The experiment suggests that extender pigments may improve scattering by preventinc pigment clusters. The broader implications of the Monte Carlo plotting experiments are discussed. Optical experiments are described which demonstrate the ability to investigate the intensity of scattered and transmitted light as a function of angle. The experiments involved the determination of simulated powder mixtures. Author

N66-12968*# Bausch and Lomb, Inc., Rochester, N. Y. Grating Research Section.

GRATING GROOVE FORMATION IN Av AND Av–Ge ALLOYS. SURFACE POLISH EFFECTS ON Av MIRRORS Final Report, 1 Apr.–30 Sep. 1965

C. Frank Mooney 25 Sep. 1965 56 p refs Prepared for NRL (NASA Order R-107; Contract Nonr-4277(00) (X))

(NASA-CR-68310) CFSTI: HC $3.00/MF $0.50 CSCL 20F

A study of the influence of technique procedures on the appearance of electron micrographs of mirror surfaces and a study both by electron microscopy and by vacuum ultraviolet reflectometry of effects ascribable to surface polish are reported. Also, the equipment and procedures used are presented. It was found that any object that can be observed to have a shape in one of the electron micrographs is not some artifact of the electrons, the C-film substrate, the Pt-C shadow deposit, or photographic practice. Further, the transfer films of gold have many times higher reflectance than thick 0.4 micron first surface gold films in the ultraviolet. There is also evidence that transfer mirrors made from glass polished under liquid are better than conventionally polished mirrors. E.E.B.

N66-13004# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ESTIMATE OF THE ABSOLUTE VALUE OF THE EFFECTIVE CROSS-SECTION OF IMPACTS OF THE SECOND KIND IN $N_2 + Ar$, $CO + Ar$, $N_2 + CO$ MIXTURES BY THE MAGNIFICATION OF MOLECULAR BANDS IN A GLOW DISCHARGE

L. A. Chernenko and N. A. Prilezhaeva [1965] 6 p refs Transl. into ENGLISH from Zh. Prik. Spektr. (USSR), v. 3, no. 1, Jul. 1965 p 9–13

The dependence of the line or molecular band intensity on the partial pressures of the mixture components in a glow discharge was investigated to estimate the absolute value of the effective cross section of impacts of the second kind. The determination of the cross section was based on the measurement of the relative intensities of the appropriate bands in mixtures of different percentage composition. It was found that exaggerated values of the effective cross sections for the molecular gases are apparently associated with the specifics of excitation of the vibrational and rotational states for impacts of the second kind. R.R.D.

N66-13035# ACF Industries, Inc., Albuquerque, N. Mex.
FILAMENT WOUND SPHERE WITH POLAR OPENING
L. A. Ney 4 Jan. 1965 11 p
(Contract AT(29-1)-1352)
(ACF-9; ACF-SA-706)

A filament-wound sphere with a polar opening under internal pressure was analyzed with a view to optimization of the wrap pattern on a 2-in. dia sphere with 0.5-in. polar opening and a 20,000-psi burst pressure. Computer calculations were made for pole radii of 0 to 0.40 in. NSA

N66-13048*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MAGNETIC FIELDS DUE TO SOLID AND HOLLOW CONICAL CONDUCTORS
James C. Stoll, Peggy L. Yohner, and James C. Laurence Washington, NASA, 1965 133 p refs
(NASA-SP-3022) CFSTI: HC $1.00/MF $1.00 CSCL 20C

The axial and radial components of the magnetic field produced by a solid, finite-length conical conductor with a constant azimuthal current density were derived, and numerical results were computed for several values of the half cone angle. The triple integrals giving the field values were integrated twice analytically; the third integration was done numerically on electronic computers using Gaussian integration. Axial and radial magnetic fields due to hollow conical coils or hollow frustum coils of finite thickness can be obtained from these solid cone fields by superposition. Author

N66-13093*# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.
ON THE STABILITY OF EQUILIBRIUM OF CONTINUOUS SYSTEMS Technical Report No. 65-1
S. Nemat-Nasser and G. Herrmann Mar. 1965 25 p refs
(Grant NsG-605)
(NASA-CR-68434) CFSTI: HC $1.00/MF $0.50 CSCL 20K

A sufficiency theorem for the stability of a linearly viscoelastic solid subjected to partial follower surface tractions is established. It is shown that an appropriately defined functional metric space must be introduced in order to formulate a well-posed problem. The usual energy method, if applicable, and the Galerkin method, if convergent, yield stability conditions only in a function space whose metric is defined in an average sense. Author

N66-13211# Michigan Univ., Ann Arbor. Background Analysis Center.
ANALYSIS OF RETICLE SYSTEMS
John P. Ulrich, W. Duane Montgomery, and James L. Alward Oct. 1965 63 p refs
(Contract ARPA SD-91)
(Rept.-6054-2-T; AD-472560)

This report presents a review of the existing mathematical treatments of reticle systems. Suggestions are made for more satisfactory analytical procedures, and detailed mathematical analyses of a number of reticles, scene components, and specific reticle-scene combinations are presented. The calculation of the frequency-coding properties of any system employing an infinite periodic reticle (endless-belt reticle, for example) is reported. Geometrical interpretations for all claculations are given. Author (TAB)

N66-13227*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPERATING PARAMETERS OF THE OMEGATRON MASS SPECTROMETER IN ULTRAHIGH VACUUM
James M. Bradford, Jr. Washington, NASA, Dec. 1965 46 p refs
(NASA-TN-D-3129) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The operating parameters of the omegatron to give the maximum sensitivity were determined for helium, nitrogen, argon, and carbon dioxide for pressure from about 7×10^{-10} torr to 7×10^{-7} torr. The recommended values were 0.7 volt for the trap voltage, 8 volts for the electron collector voltage, and 1.5 volts rms for the RF voltage while using an emission current of 1 μA and an electron bias voltage of 70 volts. There is, further, a range of values for each of the operating parameters in which the sensitivity is not a strong function of the operating parameter in question. The sensitivity of the omegatron was determined to be 1.2 $torr^{-1}$ for helium, 7.5 $torr^{-1}$ for nitrogen, 11.3 $torr^{-1}$ for argon, and 17.0 $torr^{-1}$ for carbon dioxide. The operating parameters and sensitivity for a second omegatron tube were determined and were essentially the same as for the first tube. Author

N66-13228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMUM DESIGN OF MAGNETIC BRAKING COILS WITH SPECIAL APPLICATION TO LEWIS DROP TOWER EXPERIMENTS
H. G. Kosmahl Washington, NASA, Dec. 1965 25 p refs
(NASA-TN-D-3132) CFSTI: HC $1.00/MF $0.50 CSCL 20C

General analytical treatment of a design of magnetic braking coils and magnetic braking action is given. However, numerical results are computed and tabulated only for the specific application and requirements of the Lewis Research Center (400-ft) drop facility. A method for calculating the mutual inductance of unconventionally wound coils has been developed. Braking action has been computed for the case of a primary coil used to stop the motion of a secondary coil moving along the common axis and with a given mass and initial kinetic energy. The energy required in the primary coil can be minimized. The amount of deceleration can be adjusted by varying only the primary voltage (current). The preceding tasks may be accomplished with a primary system requiring a minimum number of turns. For the specific case of a freely falling payload in the Lewis 400-foot drop facility, weighing 1000 kilograms and having a final velocity of 50 meters per second, a primary power of between 10 to 20 megawatts associated with a primary current of about 100 kiloamperes is required for 10 seconds to stop the payload with a deceleration equal to or less than 30 g's. The corresponding primary magnetic field is of the order of 1 Weber per square meter (10000 gauss). Author

N66-13249# Los Alamos Scientific Lab., N. Mex.
ON THE CONVERGENCE OF DISCRETE APPROXIMATIONS TO SOLUTIONS OF MIXED BOUNDARY VALUE PROBLEMS
Neil M. Wigley 3 Dec. 1965 21 p refs
(Contract W-7405-ENG-36)
(LA-3386)

Let D be a bounded, simply connected domain in the plane with piecewise smooth boundary Γ. Let Γ be composed of two parts, Γ^1 and Γ^2. Consider the problem of finding a function harmonic in D with prescribed values on Γ^1 and with prescribed values for the normal derivative on Γ^2. Let difference equations for a mesh of width h be set up, using the five-point Laplacian together with standard difference equations near the

boundary. Let the corners of D be the points where the boundary is not smooth, together with the points common to both Γ^1 and Γ^2. Then in any subdomain which does not contain the corners, the error is of the order of h. The results apply even if the harmonic function in question has derivatives which are singular at the corners. Author

N66-13252* National Aeronautics and Space Administration, Washington, D. C.
THE NATURE OF ENERGY TRANSFER TO ELECTRODES IN A PULSE DISCHARGE WITH SMALL GAPS
B. N. Zolotykh *In its* Elec. Contacts Dec. 1965 p 1–15 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

A discharge when the current reaches tens, hundreds, and even tens of thousands of amperes, while the voltage at the electrodes when open does not exceed 100 to 200 volts is considered. In air these voltages correspond to gaps of the order of several microns, while in a dielectric liquid (oil or kerosene) they are of the order of tens of microns. It is shown that the most significant factor which controls the transfer of energy by the electrode during pulse discharge is electron and ion bombardment. Under certain conditions the energy exchange between electrodes produced by flares may be significant. In selecting contact materials or materials for the electrode used in electrospark machining, the nature of energy liberation and the thermal properties of the materials must be considered. The formation of films on the surface of the electrode or of the contact with low temperature conductivity may provide a substantial reduction of electrode wear. E.E.B.

N66-13253* National Aeronautics and Space Administration, Washington, D. C.
THEORETICAL DETERMINATION OF THE CONTACT GAP RESTORABLE STRENGTH
I. S. Tayev *In its* Elec. Contacts Dec. 1965 p 16–31 ref (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

A theoretical determination is made of the electric field strength of a contact gap by considering the basic factors which are important in the formation of the electric field strength when such devices are used to turn off an electric current. These factors include the thermionic emission from the contact heated by the arc and the ionization temperature of the gas. E.E.B.

N66-13254* National Aeronautics and Space Administration, Washington, D. C.
SELECTIVITY IN THE EMISSION OF MATERIAL FROM SOLID BINARY ALLOYS DURING PULSE DISCHARGES IN AIR
O. I. Avseyevich and I. G. Nekrashevich *In its* Elec. Contacts Dec. 1965 p 32–35 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The emission of an electrode fabricated from copper–zinc alloys with various content of copper was investigated. The erosion products were deposited on the walls of the discharge chamber. Rectangular pulses with a duration of 130 μsec were used with different amplitudes and voltages. After 240 discharges, the collected products were processed by separating the solidified droplets from the oxidized phase. The vapor products and the droplets were subjected to polarographic analysis. It was found that the erosion of the anode has a maximum for alloys with Cu concentration greater than 44% with currents of 1200 to 1500 A. For alloys with a smaller concentration of Cu the maximum occurred at 1520 A. The concentration of zinc was greater in the vapor phase of the anode erosion products than in the original anode material. Also, the total composition of the vapor phase and the liquid phase of the anode erosion products had a somewhat higher concentration of copper compared with the anode material. The magnitude of the cathode erosion was 30 to 40 times less than the anode erosion. Also, the anode erosion had a maximum value for pure zinc and decreased with copper concentration. E.E.B.

N66-13255* National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF COMPONENTS PERCENTAGE ON THE ELECTRIC EROSION OF BINARY ALLOYS
N. V. Afanas'yev and A. G. Goloveyko *In its* Elec. Contacts Dec. 1965 p 36–44 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The variation of alloy erosion in electric contacts used in electro machining was investigated. It was found that the erosion of electrodes is due to the thermal effect produced by the two-dimensional bombardment of electrodes by electrons and ions and Joule heating. Also, the erosion of an alloy is not the sum of the erosions of all components. The evacuation of the material from the surface of the electrodes takes place in a vapor and liquid phase. The vapor phase is caused by the rapid evaporation of the liquid metal in the microbath. The ejection of the liquid phase from the microbath is caused by the pulse pressure of the shock wave. The most intense ejection of the liquid phase takes place at the end of the discharge after the molten metal has obtained a high temperature and low surface tension coefficient. Also, when a discharge takes place between electrodes made of alloys, there is a selective evaporation of alloy components; the component with the lower melting point evaporates faster leaving a concentration of the component with the higher melting point in the microbath. E.E.B.

N66-13256* National Aeronautics and Space Administration, Washington, D. C.
EROSION OF PRECIOUS METAL ELECTRODES IN AN ARC DISCHARGE
A. D. Gut'ko *In its* Elec. Contacts Dec. 1965 p 45–63 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

The study of the electric erosion of cathodes and anodes made of platinum, gold, silver, and certain base alloys were conducted in a unipolar arc with a current of 2.0 to 10.0 A and a distance between electrodes of 1.0 to 4.5 mm. The discharge was conducted in air and in argon at normal pressures. It was observed that there is a closer relationship between the erosion in metals and the ionization energy of a given element than between erosion and other physical properties. Anode erosion was observed to increase with lower ionization energy; however, cathode erosion increased with higher ionization energy. It was concluded that material designed for the anode must contain atoms with high ionization energy and with a higher vapor elasticity than the base alloy. The cathode must consist of metals whose atoms have a low ionization energy or which have metastable states with excitation energy having a value of several electron volts. E.E.B.

N66-13257* National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF NONEQUILIBRIUM PROCESSES AT ELECTRODES IN AN ARC
A. A. Kuranov *In its* Elec. Contacts Dec. 1965 p 64–65 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

A study of the erosion mechanism in an electric arc discharge is discussed. A zone of molten metal is formed on one side which is in contact with the solid metal phase and on the

other side with the region of the arc discharge. The metal enters the region of the arc discharge from the liquid phase. If the vapor pressure of one element is higher than the vapor pressure of the other element, a depletion takes place of the evaporation surface by the element with the higher vapor pressure. The diffusion equation for the process is presented. The structure of the contact material is also of importance because diffusion over the surface and intercrystalline members is greater by a factor of 5 to 6 than the volumetric diffusion.

E.E.B.

N66-13258* National Aeronautics and Space Administration, Washington, D. C.

NATURE OF FORCES WHICH EJECT METAL DURING ELECTRIC EROSION

A. S. Zingerman *In its* Elec. Contacts Dec. 1965 p 66–76 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Experiments were conducted to determine the mechanism of electrode erosion in electric arc discharges. Energy pulses from 300 to 4000 W were used. The experimental data confirmed the dependence of the erosion mechanism on the pulse power. High-speed motion picture photography was used to verify the conclusions drawn from experimental data and to study the ejection of the metal from the electrodes during electric erosion. The high-speed photographs confirmed the conclusion that the mechanism of metal ejection depends on the pulse power. At low powers the ejection mechanism is predominately vaporous, while at high powers it is of the liquid-drop type.

E.E.B.

N66-13259* National Aeronautics and Space Administration, Washington, D. C.

COMPUTING THE CONTACT AREAS OF STATIONARY AND SLIDING CONTACTS

I. V. Kragel'skiy, N. B. Demkin, and N. N. Mikhin *In its* Elec. Contacts Dec. 1965 p 77–91 refs (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Design equations for determining the effective contact area of stationary contacts are given and the nature of contact making, which determines the formula to use in the calculations, is discussed. The criteria for contact making, the ratios of the penetration depth h to the radius of the roughness r, is considered. Approximate calculations have shown that plastic contact occurs when $h/r = 0.01$ for ferrous metals and $h/r = 0.0001$ for the light metals. Also, plastic contact predominates during the first loading of the surfaces and when the surfaces slide as they wear. Elastic contact takes place when any surface is loaded with a force which does not exceed the initial applied force. Conditions for both types of contact are described and equations, verified by experiment, are given.

E.E.B.

N66-13264* National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE FINE TRANSFER OF MATERIAL ON SILVER CONTACTS

A. Khench *In its* Elec. Contacts Dec. 1965 p 137–143 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

Three methods of measuring fine transfer of material in silver contacts were investigated. The gravimetric method involves weighing accurately the material transported to the cathode. A more accurate version is to convert the silver into dithio-ozonate. This is separated by filter and quantitative data obtained by comparison with standard data. However, not all of the transported particles can be determined. The volumetric-analytic method uses a microscope to enlarge the image of the contact from which its volume is computed. This method erroneously assumes that the deposits are conical or cylindrical. Another version uses a diamond probe to feel the deposit surface. Variations in the probe's position are magnified by an electromechanical induction transducer, taped, and a topographic picture made from the tape. Flat surfaces are difficult to measure. The third method uses a radioactive silver anode and an ordinary silver cathode. The active products transported from the anode to the cathode are counted. However, accuracy is limited by the power of the neutron flux entering the counter and permissible dose of activity. Also, this method only determines the transfer at the contact, while the amount of the splashed and evaporated material cannot be determined.

R.N.A.

N66-13265* National Aeronautics and Space Administration, Washington, D. C.

ARC QUENCHING AT CRITICAL dc CURRENT VALUES

R. S. Kuznetsov, P. M. Zemskov, and V. A. D'yachkova *In its* Elec. Contacts Dec. 1964 p 144–147 (See N66-13251 03-09) CFSTI: HC $7.45/MF $2.25

A method is presented for determining the conditions for arc quenching at critical dc current values in circuits with an inductive load.

R.N.A.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-12268# Oak Ridge National Lab., Tenn.

INVESTIGATIONS OF THE ISOTOPE EFFECT DURING THE SECONDARY ELECTRON EMISSION AT METAL SURFACES BY POSITIVE IONS

Karl Heinz Krebs [1965] 5 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), Ser. 7, v. 15, 1965 p 111–112 (ORNL-TR-680)

Secondary electron emissions at metal surfaces by positive ions were investigated for elements with more than two stable isotopes to determine isotope effect. A nickel target was bombarded with krypton and xenon ions and the mean number of emitted secondary electrons per impacting ion was determined, and plotted. Mean number was also plotted over the isotope mass and M/e for various energies. Additional tests are underway with other isotope ions and different target materials.

M.W.R.

N66-12272# Los Alamos Scientific Lab., N. Mex.

COMPUTATION OF FAST NEUTRON PENETRATION IN AIR BY THE "Sn-METHOD" WITH SPECIAL EMPHASIS ON THE USE OF "MULTITABLE-MULTIGROUP CROSS SECTION SETS"

H. A. Sandmeier, G. E. Hansen, R. B. Lazarus, and R. J. Howerton (Lawrence Radiation Lab.) 17 Nov. 1965 66 p refs (Contract W-7405-ENG-36) (LA-3415) CFSTI: $3.00

Much theoretical work has been done in the past to represent the angular dependence in the scattering source term of the Boltzmann equation by means of Legendre or other series expansions. However, relatively little work has been done to

feed this information into our present day Sn codes. The Sn-transport codes allow a representation of anisotropy in the scattering-source term by means of multitable cross section sets, and a formalism is developed to generate these sets. The numerical evaluation of Sn cross section entries for these multi-table sets has been computerized. Deep penetration calculations (3000 meters) of high energy neutrons in homogeneous air are presented. These calculations used recently evaluated basic cross section data for nitrogen and oxygen. The variations in the neutron flux due to different approximations are discussed as are the expected variations in the flux due to inaccuracies in cross section data. Author

N66-12284# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

EFFECTIVE CROSS-SECTION FACTORS

R. G. Nisle Aug. 1965 90 p refs

(Contract AT(10-1)-205)

(IDO-17107) CFSTI: $3.00

An alternative to the cadmium ratio concept is reviewed and the advantages are discussed. The basis for this alternative concept is Westcott's conventional flux, Campbell and Freemantle's description of the joining function between Maxwellian and 1/E flux components, and a proposal of Gavin's for the measurement of neutron temperature. The derived formalism leads to an effective cross-section factor, $P_x(F_1,T)$ that amounts to a flux weighted average. $P_x(F_1,T)$ may be calculated for any isotope, x, from differential cross-section data by direct integration, or in special cases by a simplified formula. Tables of the factor $P_x(F_1,T)$ for ten values of F_1 and fourteen values of T have been calculated and are presented here for most of the elements and isotopes of interest to reactor engineers. Author

N66-12288# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

THE ALGEBRA OF CURRENTS AND LOW ENERGY K π-INTERACTION

V. S. Mathur and L. K. Pandit 22 Oct. 1965 18 p refs Submitted for Publication

(Contract AT(30-1)-875)

(UR-875-103)

Using Fubini–Furlan–Adler–Weisberger technique, sum rules have been written down for strangeness-changing and strangeness-preserving axial vector coupling constants. Coupled together these sum rules provide information on the low energy interactions of strongly interacting particles. In particular the Kπ system is studied and a case made for the existence of an S-wave resonance near threshold in the I = 1/2 channel. An evaluation of the KNΛ—and KNΣ—coupling constants required by the mutual consistency of the sum rules is also presented. Author

N66-12295# General Dynamics Corp., San Diego, Calif. General Atomic Div.

INTEGRAL NEUTRON THERMALIZATION Annual Summary Report, 1 Oct. 1963–30 Sep. 1964

J. R. Beyster, J. R. Brown, N. Corngold, H. C. Honeck, D. H. Houston et al Washington, AEC, 15 Oct. 1965 228 p refs

(Contract AT(04-3)-167)

(GA-5798) CFSTI: $6.00

Various research programs, conducted to provide realistic theoretical procedures for describing slow neutron scattering from bound atoms and to correlate experimental tests of these procedures under appropriate reactor design conditions, are described. Aspects include D_2O spectral investigations; measurements of scattering angular distributions; BeO spectral measurements; studies of space dependent problems, and of fast neutron shielding; and theoretical studies of neutron thermalization in polyethylene, zirconium hydride, beryllium, and BeO. A general computer code, capable of calculating the scattering kernel for most moderators, was also developed. Other investigations covered the phenomena of the scattering kernel for polyethylene, and the lattice vibrational spectra of magnesium and zinc. Data on 29 neutron spectra, compiled for the neutron spectrum book, are presented; these give measured and theoretical neutron spectra for a variety of poisons and moderators at different temperatures, and in several geometries. M.G.J.

N66-12343# Oak Ridge National Lab., Tenn.

ON THE ABSOLUTE VALUE AND ENERGY DEPENDENCE OF THE ^{3}He(n,p)T REACTION

R. L. Macklin and J. H. Gibbons [1965] 8 p refs Presented at the Intern. Conf. on the Study of Nucl. Struct. with Neutrons, Antwerp, 19–23 Jul. 1965

(Contract W-7405-ENG-26)

(ORNL-P-1375; CONF-650706-16)

Proton beam currents of from 0.05 to 1.0 μa were used. The tritium targets were composed of tritiated titanium thin films (14–25 μ gm/cm^2) on a variety of metal backings. The ^{49}Ti(p,n) threshold limited the proton energies used to about 1.4 Mev. Target thickness varied from 2 to 4 kev for 1 Mev protons. The final yield results were converted to ^{3}He (n,p)T by detailed balance and normalized to a value of 1980 mb at 100 kev. NSA

N66-12358# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

MULTI-GROUP DISCRETE Sn TRANSPORT CALCULATION FOR CYLINDRICAL GEOMETRY

Ronald M. Saqui (M.S. Thesis) May 1965 114 p refs

(GNE/PHYS-65-17; AD-621021)

A computer code is presented for neutron transport calculations on a cylindrical geometry, gaseous core, nuclear rocket. The code is applied to a simplified reactor system model consisting of a two region right cylindrical cavity core with an effective temperature of 2980° K. The calculations are performed using a five energy group, discrete S4 approximation of the Boltzmann equation. The cylindrical form the the Boltzmann equation is developed in detail. Application of the discrete Sn approximation to obtain the finite difference equations and the boundary conditions is shown. An iterative procedure having the total fission source production as the eigenvalue is used by the computer code to solve these equations numerically. This code is written in Fortran IV language for the IBM 7094 coupled system. The atom density results of the two systems tested are within 2.5% and 0.6% agreement with those of another code written by T. F. Plunckett of Douglas Aircraft. Although these results are good, variations in the multiplication factor and the inability to significantly effect this factor by small changes in system parameters leads to the conclusion that further tests of the code are required before it may be used in the analysis of the propulsion device. Author (TAB)

N66-12436# Los Alamos Scientific Lab., N. Mex.

THERMAL NEUTRON SPECTRA FROM AN UNDERGROUND NUCLEAR EXPLOSION WITH SPECIAL CONSIDERATION OF SPECTRAL MODIFICATION DUE TO BOMB DEBRIS MOTION

Henry A. Sandmeier and Gordon E. Hansen 12 Nov. 1965 47 p refs
(Contract W-7405-ENG-36)
(LA-3403) CFSTI: $3.00

The neutron flux from an underground nuclear explosion has recently been used to measure nuclear cross sections. For the experimenter it is of interest to know the neutron spectrum and intensity emerging from the top of the pipe leading to the nuclear device. A short time following the nuclear explosion and after many fast neutrons have escaped, the local neutron spectra in the bomb debris will be in thermal equilibria. The spectrum of neutrons leaking from this debris will depend on a superposition of these local Maxwell Boltzmann distributions each with its characteristic drift velocity. Theoretical expressions are derived for the low energy neutron spectrum emerging from a long narrow pipe. The theoretical predictions agree reasonably well with measurements obtained from the Parrot Shot in Nevada in the Spring of 1965. Author

N66-12559# Stanford Univ., Calif. Dept. of Physics.
NEUTRON FORM FACTORS FROM INELASTIC ELECTRON-DEUTERON SCATTERING
E. B. Hughes, T. A. Griffy, M. R. Yearian, and R. Hofstadter Jan. 1965 62 p refs
(Contract Nonr-225(67))
(HEPL-360; AD-619575)

The electromagnetic form factors of the neutron have been measured in the q-squared range from 1.0 to 30.01/F sq. It is found that for values of q-squared greater than about 6.01/F sq the square of the neutron's charge form factor is consistent with zero to within an error of the order of 5% in the existing theoretical cross section. For values of q-squared less than 6.01/F sq it is concluded that meaningful values of the neutron form factors cannot be given until the necessary corrections to the theory are better undersrood. The present results on the neutron form factors are combined with recent measurements of the proton form factors to provide experimental determinations of the isotopic nucleon form factors. It is found that the omega and phi mesons provide a good approximation to the observed isoscalar form factors but that it is difficult to understand the behavior of the isoverector form factors in terms of the rho meson alone. Author (TAB)

N66-12656# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
CHARGE CONJUGATION IN UNITARY SYMMETRY GROUPS
S. Okubo and N. Mukunda (Princeton Univ.) 16 Sep. 1965 21 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-95)

Charge conjugation transformation law for infinitesimal generators of unitary symmetry groups like SU(2), SU(3), (or more generally SU(n)) and $\tilde{U}(12)$ has been derived from requirements that the charge conjugation is an automorphism of the group and furthermore that it changes signs of ordinary and hyper charges. Author

N66-12681 Mound Lab., Miamisburg, Ohio.
EFFECTIVE HALF-LIFE OF POLONIUM
W. E. Sheehan *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 32–38 refs (See N66-12676 03-06) CFSTI: $2.50
(Contract AT(33-1)-GEN-53)

Data on the elimination of polonium are presented for two cases of exposure, one by puncture with a contaminated wire and one by inhalation of polonium. The effective half-life of polonium in the inhalation case was 33 days, but the biological half-life of the puncture case was 24 days. Author

N66-12688 Los Alamos Scientific Lab., N. Mex.
STATUS AND APPLICATION OF THERMOLUMINESCENT DOSIMETRY SYSTEMS
Edwin A. Bemis *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 110–135 refs (See N66-12676 03-06) CFSTI: $2.50

Thermoluminescence is broadly defined as the emission of light when a solid is heated to a temperature below that of incandescence. If the amount of light emitted can be related to the absorbed dose (or absorbed dose rate) deposited by ionizing radiation, the material can serve as the basis for a dosimetry system. Since the first report by Becquerel in 1883, a variety of thermoluminescent materials have been found. Recent developments have now made practical systems possible, the most highly developed ones utilizing appropriately "activated" LiF and CaF_2. A few of the useful characteristics of such systems include: a very great dynamic range, from a few mr to 10^4 r and higher; usually a very small loss of information before read-out, as low as 5% per year at room temperature; and ability to measure extremely high radiation rates, 10^9 r/sec. Author

N66-12694 Combustion Engineering, Inc., Windsor, Conn.
THE DETERMINATION OF U^{235} BY PULSE HEIGHT ANALYSES
Reynold L. Hoover and Robert L. Hancock *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 171–173 (See N66-12676 03-06) CFSTI: $2.50

The equipment and procedures used to detect U^{235} are described. Uranium-235 in > .01 mg amounts may be detected by gamma scintillation counting on the .184 MeV peak of a pulse height analyzer. The .184 MeV peak is specifically proportional to the uranium-235 content of uranium samples. By counting at .150 to .200 MeV, the area under the .184 MeV photopeak will not detect other uranium, radium, or thorium gamma activities, thus eliminating their interference. A multichannel gamma spectrometer was also used to scan the entire uranium spectrum and measure the area under the photopeaks of samples compared to standards to determine uranium-235. R.W.H.

N66-12696 Hanford Atomic Products Operation, Richland, Wash.
THE DIRECT MEASUREMENT OF RADIONUCLIDES IN BIOASSAY SAMPLES BY MULTIDIMENSIONAL GAMMA-RAY SPECTROMETRY
R. W. Perkins *In* AEC Bioassay and Anal. Chem. Meeting [1964] p 179–200 refs (See N66-12676 03-06) CFSTI: $2.50
(Contract AT(45-1)-1350)

A detector system is presented which provided ultralow background and high counting efficiency plus minimum Compton response, and used coincidence techniques to make use of the individual gamma-ray decay characteristic of each radionuclide for its identification and measurement. In this spectrometer system the sample was viewed by two large detectors for normal and coincidence gamma-ray spectrometry, and the detectors were contained in a third detector which serves as an anticonicidence annulus for Compton and background suppression. A multiparameter analyzer was used for storing the normal and coincidence spectra. The levels of cosmic ray produced Na^{22} and also of Cs^{134} in bioassay samples were compared with the observed levels in the principal foods of the diet. The advantages of this instrumental method over whole body counting and other bioassay methods are discussed. R.W.H.

N66-12779# Stanford Univ., Calif. High-Energy Physics Lab.
LINEAR ELECTRON ACCELERATOR PROJECT Status Report, 1 Nov. 1964–31 Jan. 1965
R. G. Gilbert et al Feb. 1965 38 p
(Contract Nonr-225(67))
(HEPL-362; AD-619576)

Research with Mark II and Mark III continued with both accelerators operating reliably. The colliding beams experiment achieved a major breakthrough in the wide angle electron-electron scattering events were observed with a high signal to background ratio. The number of observed events corresponds within a factor of two to the number expected from the experimentally measured beam parameters. Although the rate of events is small it will be sufficient to provide an interesting test of quantum electrodynamics. The beam switchyard for the new target area is now completed to the extent that we are ready for preliminary runs using the new target area. The electron scattering program on Mark II has recently included a study of elastic scattering at 180 degrees. The measurements extend into a region of lower momentum transfer than is conveniently available on Mark II and thus they are a valuable complement to these interesting studies of the static magnetic moments of nuclei. The elastic scattering of electrons from the deuteron at large angles where magnetic scattering dominates, shows an interesting effect which could be the result of meson currents. The effect was first observed using the 180 degrees scattering apparatus at Mark II. A more pronounced effect using Mark III at momentum transfers of about 500 MeV/c has now been observed. Author (TAB)

N66-12817# Naval Research Lab., Washington, D. C.
FILTER PACK TECHNIQUE FOR CLASSIFYING RADIOACTIVE AEROSOLS BY PARTICLE SIZE. PART 4: MATHEMATICAL CONSIDERATIONS
Robert M. Mason, Peter C. Ryan, and Sarah L. Hill 9 Aug. 1965 16 p refs
(NRL-6306; AD-621565) CFSTI: $1.00

Passing an air stream through a sequence of filters having different retentivities effects some classification of radioactive particles by size. Airborne radioactivity has been related to particle size by a system of four simultaneous linear algebraic equations in four unknowns. Each equation expresses the total radioactivity collected on a given filter in terms of the total activity for each size group and the probability for particles of that group being trapped on that filter. A preliminary set of filter pack collection data was used to determine a coefficient matrix for the system based on these probabilities. The system was then applied to new data. This procedure can be applied to a variety of filter pack constructions for relating other characteristics of atmospheric particles to particle size.
Author (TAB)

N66-12862*# Alabama Univ. Research Inst., Huntsville.
ADIABATIC EXCHANGE APPROXIMATION IN ELECTRON SCATTERING FROM MULTI-ELECTRON ATOMS
W. R. Garrett Sep. 1965 44 p refs
(Grant NsG-381)
(NASA-CR-68239; UARI-19) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The problem of low energy atomic scattering of electrons by multi-electron atoms is formulated in the adiabatic exchange approximation. The effects of target distortion by the electric field of the incident charged particle are determined by computing a polarization potential to be included in the total scattering interaction. The polarization potential is obtained through a polarized orbital calculation on atomic systems described by Hartree–Fock type wave functions. Application is made to Na and Li where electron exchange is included in the reduction of the scattering equation, and the phase shifts and total elastic scattering cross sections are obtained through the solution of a set of integrodifferential equations. Exchange effects are noted explicitly by solving the scattering equations neglecting electron exchange and comparing the computed cross sections. The total elastic scattering cross sections for Li and Na agree well with recent measurements over the entire experimental range, and are significantly better than any previously published results. Author

N66-12876# Stanford Univ., Calif. High-Energy Physics Lab.
PHOTODISINTEGRATION OF THE DEUTERON FROM 500 TO 1000 MeV.
R. Ching and C. Schaerf Jul. 1965 11 p refs Submitted for Publication
(Grant Nonr-225(67))
(HEPL-395; AD-468910)

The photodisintegration of the deuteron has been studied at energies comparable with the second and third pion-nucleon isobars using the Stanford Mark III linear electron accelerator. No evidence has been found for any resonant behavior in the energy region of interest. Author (TAB)

N66-12889# TRW Systems, Redondo Beach, Calif. Quantum Physics Lab.
THE ELEMENTARY PARTICLE SPECTRUM
H. C. Corben Oct. 1965 24 p refs
(Contract Nonr-3769(00))
(STL-8665-6009-RU-000; AD-622258)

The relativistic quantum theory of the symmetric top implies that the spin J of a particle state can be represented as the sum of four commuting spin operators of lengths given by the positive integers or half-integers n, n', I, I'. If (I+I') is identified with the isospin, 2 (n' − n) with the strangeness, and, where applicable, (−1) to the (n + n') power with the G parity, the simplest choices of n, n', I,I' lead to a correct description of J, I, S, G for every known strongly interacting meson or baryon state.
Author (TAB)

N66-12909# Oak Ridge National Lab., Tenn.
THEORETICAL-EXPERIMENTAL STUDY OF THE RESPONSE OF IONIZATION CHAMBERS EXPOSED TO PULSED GAMMA RADIATION
M. Ladu, M. Pelliccioni, E. Rotondi, and R. Siwicki [1964] 14 p refs Transl. into ENGLISH from Comitato Nazl. Energia Nucl. Rept. no. RT/PROT/(65)11
(ORNL-TR-715)

Effects due to the superimposition of only two pulses which reach the chamber separated by a certain variable time delay are studied. A plane ionization chamber exposed to a succession of pairs of gamma radiation pulses of identical duration and intensity is the problem considered, and the application of the results to the case of a chamber with cylindrical geometry is given. R.C.S.

N66-12914# Gosudarstvennyi Komitet po Ispolzovaniyu Atommoi Energii, Moscow (USSR).
THE ISING MODEL IN THE CASE OF INTERACTION WITH NON-PROXIMATE NEIGHBORS [MODEL' IZINGA PRI VZAIMODEISTVII S NEBLIZHAISHIMI SOSEDYAMI]
V. G. Vaks, A. I. Larkin, and Yu. N. Ochinnikov 1965 20 p refs In RUSSIAN
(IAE-863)

A two-dimensional Ising lattice is considered, in which, besides the usual interaction, between the junctions having identical parity of rows and columns, there is an interaction along the diagonals. The free energy and the spontaneous magnetization intensity are found as functions of temperature. The form of the correlation function is obtained at large distances from the point of phase transition and near to it.
Author (NSA)

N66-12928*# Cook Electric Co., Morton Grove, Ill. Tech-Center Div.
RADIOISOTOPE HEAT SOURCE EVALUATION PROGRAM
Final Report, 15 May–13 Dec. 1964
[1964] 246 p refs
(Contract NAS5-3849)
(NASA-CR-68182) CFSTI: HC $6.00/MF $1.50 CSCL 18B

The primary objective of the radioisotope heat source evaluation program was the compilation of an annotated bibliography on the nuclear characteristics of the following isotopes: strontium-90, cesium-134, cesium–barium-137, promethium-147, polonium-210, plutonium-238, curium-242, and curium-244. A secondary objective of the program was the generation of a Fortran computer program capable of computing the low energy bremsstrahlung (< 250 kev) emanated by candidate isotopic fuels. Promethium 147 was used as a typical radioisotope. At the beginning of each isotope section, the best values for the nuclear characteristics of that isotope are presented. These characteristics are: half life, spontaneous fission half life (when applicable), energy levels, decay schemes, spins, alphas/spontaneous fission (when applicable), and neutrons/spontaneous fission (when applicable). The bremsstrahlung computer program was tested using promethium-147 oxide as a typical case. In addition to the program proper a flow diagram of the program is presented along with graphs of the generated bremsstrahlung spectrum.
Author

N66-12939# Japan Atomic Energy Research Inst., Tokyo.
MANUAL OF FREE GAS MODEL CODE (FREE-CODE)
Satoru Katuragi, Yukio Ishiguro, and Tuneo Tutui Dec. 1964
10 p refs In JAPANESE; ENGLISH summary
(JAERI-1084) CFSTI: HC $1.00/MF $0.50

The code FREE is prepared to calculate, by the free gas model, the thermal neutron scattering law, Legendre moments of the scattering kernel and the thermal neutron source spectrum. The manual shows the analytical expressions for the scattering law and for the Legendre moments of the scattering kernel, which are derived from the Van Hove's formula for the differential cross section. It also shows how the thermal neutron source spectrum, dependent on the moderator temperature, is calculated numerically. Finally, the formats for the input and output are illustrated.
Author

N66-12943# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
DEGENERATED SU_4 SYMMETRY OF STRONG INTERACTIONS
V. V. Vladimirskii 1965 12 p refs In RUSSIAN; ENGLISH summary *Its* Rept.-353
(NP-15395) CFSTI: HC $1.00/MF $0.50

The assumption on the degeneration of strong interaction relative to the one of quantum numbers of the SU_4 group results in essential reduction of the number of states with different masses. Degenerated supermultiplets SU_4 are like the SU_3 supermultiplets: in the regular 15-dimension representation there is only one excess mass as compared with the octet; in the 20-dimension representation, analogous to baryonic octet, there are two ($\equiv {}_{1395}\Omega_{1560}$); and in the 20-dimension representation, analogous to the occuplet there are no excess masses. The doubling of the number of K-meson states makes it possible to get a phenomenological description of CP-parity violation in $K_2^0 \rightarrow 2\pi$ decay.
Author

N66-12945# California Univ., Berkeley. Lawrence Radiation Lab.
A MEASUREMENT OF THE POLARIZATION OF SIGMA-ZERO HYPERONS PRODUCED BY PI-MINUS MESONS ON HYDROGEN NEAR 1.3 BeV/c
Richard L. Crolius (Ph.D. Thesis) 26 May 1965 31 p refs
(Contract W-7405-ENG-48)
(UCRL-16089)

Spark chambers were used to detect $\Sigma^0 + K^0$ production by π^- mesons on hydrogen in the π^- momentum range 1200 to 1400 MeV/c. Differential cross-section measurements are presented. The differential cross sections remain unchanged, within the limits of statistics, from 1200 to 1400 MeV/c. A measurement of the Σ^0 polarization indicates that the polarization may be changing rapidly with beam momentum, but poor statistics prevent establishing this conclusively.
Author

N66-12947# California Univ., Livermore. Lawrence Radiation Lab.
THE KIRZHNITS CORRECTIONS TO THE THOMAS–FERMI EQUATION OF STATE
Shaun L. Mc Carthy 26 Aug. 1965 66 p refs
(Contract W-7405-ENG-48)
(UCRL-14364) CFSTI: $3.00

The derivation of the quantum and exchange corrections to the Thomas–Fermi model is outlined. An equation of state formulated by D. A. Kirzhnits is discussed. Expressions dealing in atomic number are given for the pressure; energy, and their quantum and exchange corrections. Numerical results of computer calculations appear in the appendix for scaled temperatures $10^{-2} \leq kT/z^{4/3} \leq 10^5$ eV. Polynomial approximations to the Fermi–Dirac integrals $I_{1/2}(\eta)$, $I'_{1/2}(\eta)$, and $I''_{1/2}(\eta)$ used in the calculation of the equation of state were evaluated by D. Harwood. The equation of state of lead according to the TF, TFD, and TFC (quantum and exchange corrected) models are compared with a Mie–Gruneisen semi-empirical equation of state from high-pressure Soviet experimental data. The comparison indicates that the TFC zero-temperature isotherm, first calculated by N. N. Kalitkin, approaches the experimental Mie–Gruneisen results more closely than the other statistical models. However, the operator expansion of the electron distribution used to evaluate the corrections in the TFC model appears to be asymptotic near normal densities and low temperatures ($kT/z^{4/3} < 10^{-2}$ eV), yielding over-correction to the pressure and energy. First-order terms become smaller with the increase of temperature and density.
Author

N66-12953# Los Alamos Scientific Lab., N. Mex.
HIGH RESOLUTION MEASUREMENTS OF GAMMA RAYS FROM NEUTRON INELASTIC SCATTERING
Robert B. Day and John M. Palms [1964] 5 p refs
(Contract W-7405-ENG-36)
(LA-DC-7096; CONF-650706-20)

A brief comparison of the new lithium-drifted germanium and the NaI neutron detector is presented. Gamma ray spectra from the neutron bombardment of gold-197, lead-206, and bismuth-209 at energies ranging from .4 to 4.1 MeV are included.
NSA

N66-12958# Argonne National Lab., Ill.
LABORATORY INVESTIGATIONS IN SUPPORT OF FLUIDBED FLUORIDE VOLATILITY PROCESSES. PART VIII: ANALYSIS OF AN ACCIDENTAL MULTIGRAM RELEASE OF PLUTONIUM HEXAFLUORIDE IN A GLOVEBOX
L. E. Trevorrow, R. W. Kessie, and M. J. Steindler Jul. 1965 22 p refs
(Contract W-31-109-ENG-38)
(ANL-7068) CFSTI: $1.00

A 5.7-g sample of plutonium hexafluoride was accidentally released to the interior of a glovebox. An analysis of the penetration of plutonium through the filter system of the glovebox has been carried out. Data obtained from an air-sampling instrument located in the effluent air stream of the filter system indicated that 2.4 μg of plutonium were released to the atmosphere during this incident. Air and surface concentrations of plutonium at sampling points beyond the exhaust stack were below the limits of detection. The performance of the high-efficiency filters of the glovebox ventilation system was generally within the range predicted from small-scale experiments that had been carried out before the incident to simulate the type of accidental release that occurred. The detailed analysis of the distribution of plutonium following the release indicated possible design improvements that could be made in the once-through air ventilation system in use. Author

N66-12978*# College of William and Mary, Williamsburg, Va.
MUON CAPTURE RATES IN COMPLEX NUCLEI
M. Eckhause, R. T. Siegel, R. E. Welsh, and T. A. Filippas (Carnegie Inst. of Tech.) [1965] 20 p refs
(Grant NsG-567)
(NASA-CR-68361) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Total disappearance rates of negative muons brought to rest in 30 elements have been measured to 1–2% precision. The experimental procedure and the results obtained are presented. In addition, a compilation of all measurements of muon capture rates in complex nuclei as presently known is given, and several analytical fits to these rates are discussed. Author

N66-13012*# Rensselaer Polytechnic Inst., Troy, N. Y.
SCATTERING BY NONSPHERICAL SYSTEMS
J. Mayo Greenberg, Arthur C. Lind, Ru T. Wang, and Louis F. Libelo [1965] 54 p refs Sponsored by NASA and NSF Prepared in cooperation with Naval Ordnance Lab.
(NASA-CR-68293) CFSTI: HC $3.00/MF $0.50 CSCL 20H

Theoretical and experimental results on the scattering by nonspherical particles whose size is of the order of the wave length are presented. A method of solution of the problem of scattering by axially symmetric penetrable particles using approximate matching of boundary conditions is applied to the scattering by prolate spheroids. Application is made specifically to the scattering of a scalar wave incident along the symmetry axis. In comparison with exact scattering coefficients for the sphere, it is shown that the "approximate" method yields results as close as one wishes to the exact results. Calculations are presented for particle sizes ranging from those small enough to be calculated by the Rayleigh approximation to sizes generally beyond the first major resonance in the total cross-section curve. Numerical calculations are made for the tilted infinite dielectric cylinder. Some new and interesting properties of the scattering efficiency as a function of orientation are demonstrated. Particularly noted is the existence of a polarization reversal as a consequence of tilt for thin cylinders. A new and improved method for obtaining microwave scattering by small particles is applied to the consideration of the detailed dependence on orientation of the cross-section of prolate spheroidal particles. Author

N66-13037# Kernforschungsanlage, Juelich (West Germany).
THE GEOMETRY ERROR IN ABSOLUTE COUNTING WITH THE β-γ COINCIDENCE METHOD. THE STATISTICAL ERROR IN ABSOLUTE COUNTING WITH THE β-γ COINCIDENCE METHOD [DER GEOMETRISCHE FEHLER BEI DER ABSOLUTZAHLUNG MIT DER β-γ-KOINZIDENZMETHODE. DER STATISTISCHE FEHLER BEI DER ABSOLUTZAHLUNG MIT DER β-γ-KOINZIDENZMETHODE]
Gerhard Erdtmann Feb. 1965 17 p refs In GERMAN
(JUL-227-CA) CFSTI: HC $1.00/MF $0.50

In the β-γ coincidence measurement of decay rates of radioactive nuclides an error occurs in the use of counters with large volumes (as for instance in liquid scintillators) since the counting yield is site dependent for β and γ rays. This error was calculated for cylindrical detectors. In an approximately cylindrical arrangement of the detectors it is negligently small. A general formula valid for the calculation of the statistical error in absolute counting with β-γ coincidence detectors was derived. NSA

N66-13055# Concordia Coll., Moorhead, Minn.
AUTOIONIZATION OF GASES BY ION IMPACT Final Report, 15 Mar.–31 Aug. 1965
M. Eugene Rudd and Chester A. Sautter 1 Sep. 1965 9 p refs
(Contract AT(11-1)-1277)
(COO-1277-13)

The technique of observing the energy spectrum of electrons from gases bombarded with ions is discussed. The energies of the more prominant lines in helium and neon are tabulated. Also, lines detected in argon and krypton are given. The helium spectrum has been studied and the energy level scheme well understood; however, only a few lines have been identified for the heavier rare gases. E.E.B.

N66-13059# Los Alamos Scientific Lab., N. Mex.
ON FREQUENCY DISCRETIZATION AND CONSERVATIVE DIFFERENCE EQUATIONS FOR RADIATIVE TRANSFER
Burton Wendroff 20 Sep. 1965 19 p refs
(Contract W-7405-ENG-36)
(LA-3401-MS) CFSTI: $1.00

In a previous publication, LAMS-2795, *On the Computation of the Transport of Radiation* (1962), we obtained finite difference approximations to the transport equation by the method of characteristics. In this paper that method is generalized to obtain completely conservative difference equations. We also propose a method of frequency discretization which allows retention of a large part of the information ordinarily lost if the absorption coefficient is simply averaged. It is shown that the difference equations behave correctly in the limit of large or small absorption coefficient. Author

N66-13075# California Univ., Berkeley. Lawrence Radiation Lab.
SAMPLING BIAS IN SCANNING PROTON-RECOIL TRACKS IN NUCLEAR EMULSION
Richard L. Lehman, Olga M. Fekula, and J. Robert Wayland, Jr. 7 Oct. 1964 35 p refs
(Contract W-7405-ENG-48)
(UCRL-11703)

A new rapid method, suitable for use with automatic coordinate readout microscope, of sampling track distributions

in nuclear emulsion was treated for bias. Length and angular distributions of track samples taken using this method from emulsions exposed *edge-normal* to single-energy neutron beams were compared with those predicted by S-wave scattering theory. No significant sampling bias was found.
Author

N66-13103# Atomics International, Canoga Park, Calif.
THE PRODUCTION OF HYDROGEN AND HELIUM IN REACTOR FUEL-CLADDING MATERIALS
Harry Alter 16 Nov. 1964 27 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-10626)

The amounts of hydrogen and helium gas produced by the constituents of several reactor fuel-cladding materials were calculated. In all instances it is assumed that the fuel-cladding material has been exposed to a fast neutron flux of 10^{16} $m/cm^2/sec$ for a period of two years. The preliminary results permit the calculation of hydrogen and helium production for other fuel clad materials.
Author

N66-13104# Oak Ridge National Lab., Tenn.
SINGLE AND MULTI-NUCLEON TRANSFER REACTIONS INDUCED BY NITROGEN-14
Rudolph M. Gaedke Sep. 1965 77 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1218)

The $O^{16}(N^{14}, F^{18})C^{12}$ reaction was investigated by obtaining angular distributions of F^{18} particles and total cross sections for the reaction at 20 MeV, 27 MeV, and 33 MeV incident N^{14} energies. Emphasis was placed on obtaining information about the reaction mechanism and comparing angular distributions for single and multinucleon transfer reactions at these energies. It was found that the ratio of neutron reduced widths in N^{14} and F^{18}, obtained from the thick-target excitation functions, were consistent within the accuracy of the data and the uncertainties of the theoretical interpretation. The $O^{16}(N^{14}, F^{18})C^{12}$ reaction proceeds predominantly by a direct reaction mechanism, and it appears that the alpha particle transfer to the first excited state in C^{12} is an important reaction channel. The angular distributions are similar to other four-nucleon transfer angular distributions obtained at similar energies with respect to the Coulomb barrier energy.
C.T.C.

N66-13108# California Univ., Livermore. Lawrence Radiation Lab.
SURFACE IONIZATION OF THE ALKALI METALS BY HEATED TUNGSTEN
Robert H. Mc Farland and John D. Kinney 21 Jul. 1965 8 p refs
(Contract W-7405-ENG-48)
(UCRL-14117)

Direct measurements of the surface ionization efficiency of lithium and sodium beams on hot tungsten were made. This involved monitoring the hot wire ion signal over tens of hours for known oven loads of metal. The results indicate that the reflection coefficient of the incident atom is zero and that the ratio, $1 - r_a/1 - r_+$, involving reflection coefficients of the temperature equilibrium atom and ion, is unity. Evidence in support of these results exists in terms of the observation that classically computed absolute ionization cross sections agree with measured ones, providing the above conditions on reflection coefficients are assumed.
Author

N66-13113# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
PREPARATION OF THIN VYNS FILMS [PREPARATION DE FILMS MINCES DE VYNS]
René Blanc, Paul Chedin, and Andrée Gizon Jun. 1965 14 p refs In FRENCH
(CEA-R-2803) CFSTI: HC $1.00/MF $0.50

Preparation and testing are discussed for thin films of VYNS, a copolymer containing vinyl acetate and chloride. Flow times for various concentrations of VYNS solutions are tabulated from results obtained with both mechanical and manual techniques. Surface densities given for two VYNS solutions as well as other data indicate surface density to be a function of concentration. A comparison made of VYNS thin films with those of formvar concludes that the latter has advantages with respect to quality.
Transl. by M.W.R.

N66-13116# European Atomic Energy Community, Brussels (Belgium).
A METHOD OF NUMERICAL SOLUTION OF THE INTEGRAL TRANSPORT EQUATION IN THE ONE VELOCITY AND ISOTROPIC SCATTERING APPROXIMATION [RISOLUZIONE NUMERICA DELL'EQUAZIONE INTEGRALE DEL TRASPORTO NELLA APPROSSIMAZIONE A UNA VELOCITA E SCATTERING ISOTROPO (TEORIA GENERALE)]
B. Montagnini (Milan Univ.) 1965 52 p refs *In* ITALIAN
(EUR-2411.i) CFSTI: HC $2.00/MF $0.50

Formulas are evolved for a numerical solution of the integral transport equation, and transport theory is discussed. A geometric approximation considers velocity and isotropic scattering; and applications to problems in one and two dimensions are given. Corrections for degenerating nuclei and for the final charge are presented.
Transl. by M.W.R.

N66-13118# Battelle-Northwest, Richland, Wash.
A MULTIPHONON NEUTRON SCATTERING STUDY OF HYDROGEN BONDING IN ZIRCONIUM HYDRIDE
O. K. Harling and B. R. Leonard, Jr. 2 Aug. 1965 22 p refs
(Contract AT(45-1)-1830)
(BNWL-SA-239; CONF-650932-1)

The rotating-crystal spectrometer was used to investigate the hydrogen bonding in a sample of ZrH. Scattered neutron spectra were obtained at scattering angles of 15- to 165-degrees for incident energies of 0.504, 0.386, and 0.100 eV. The overall resolution on energy changes was from 4% to about 20% for neutrons scattered from the first three vibration levels. The observed energies and widths of the first three levels were found to be 141.4 ±3, 280.9 ±8, 411 ±9, and 26.4 ±0.6, 52.2 ±3.7, 72 ±6 meV, respectively. Resolution corrections were applied to these energy widths. The angular distributions of elastic scattering and of the inelastic scattering from the first three vibration levels were compared with theory, assuming that the hydrogen atom is bound in an isotropic harmonic potential well.
Author

N66-13119# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
LITHIUM-INDUCED REACTIONS AND THE STRUCTURE OF LIGHT NUCLEI
L. Rotter 1965 17 p refs
(JINR-E-2243) CFSTI: HC $1.00/MF $0.50

The simple Butler theory for stripping reactions is applied to lithium induced reactions, and some characteristic differences between deuteron and lithium induced reactions are considered. The angular distributions and the spectra of the

light final products are discussed. It is shown that the simple theory with plane waves (without considering Coulomb interactions) can be used to explain some characteristic features of lithium induced reactions. C.T.C.

N66-13120# Oak Ridge National Lab., Tenn.
LEVEL SPACING AND s-WAVE NEUTRON STRENGTH FUNCTION OF THE ODD-Z ODD-N NUCLIDE ^{138}La
J. A. Harvey and G. G. Slaughter 1965 4 p refs
(Contract W-7405-ENG-26)
(ORNL-P-1354; CONF-650706-2)

Neutron transmission measurements from 0.2 to 2000 ev in 4 different energy ranges were made with the ORR fast chopper time-of-flight neutron spectrometer using BF_3 proportional counters at the 45 meter flight station. Diagrams are given relating the time of flight and transmission data. A brief discussion of the resonances is included. NSA

N66-13121# California Univ., Berkeley. Lawrence Radiation Lab.
LOW-LYING ENERGY STATES IN NINE-VALENCE-ELECTRON DIATOMIC MOLECULES
Martin D. Shetlar (Ph.D. Thesis) 5 Apr. 1965 60 p refs
(Contract W-7405-ENG-48)
(UCRL-11979)

The electronic spectra of a number of diatomic molecules with nine valence electrons were studied experimentally to determine whether unobserved low-lying energy states existed for them. The results of these experiments are correlated with previous results from the literature in an effort to clarify a number of questions pertaining to the low-lying energy states of these molecules. Problems requiring further work are pointed out. Author (NSA)

N66-13123# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
FIELD-THEORETIC MODELS OF ELEMENTARY PARTICLES
R. E. Marshak 11 Oct. 1965 44 p refs Presented at the Intern. Conf. on Elementary Particles, Kyoto, 24–30 Sep. 1965
(Contract AT(30-1)-875)
(UR-875-100)

Quantum field theory is considered relative to developing a unified field theory of elementary particles. Some of the progress which has been made with this type of approach is sketched, and lines of future investigation are suggested. The quark model, based on a triplet of massless 4-component Dirac fields interacting via a four-fermion interaction of the (V-A) type, is shown to be useful in developing a theory of leptons side by side with a theory of hadrons and a fortiori, a unified field theory of all elementary particles. C.T.C.

N66-13136# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DETERMINATION OF PARITY IN REACTIONS INDUCED BY GAMMA QUANTA
S. M. Bilenkii and R. M. Ryndin 8 Jul. 1965 7 p refs
(JINR-E-2259) CFSTI: HC $1.00/MF $0.50

Methods to determine the intrinsic parities in reactions of the type $\gamma + a \rightarrow b + c$ are considered. Two real mutually orthogonal unit vectors $\vec{e}_1$ and $\vec{e}_2$ in the plane perpendicular to the photon momentum were chosen, the vector $\vec{e}_1$ is assumed to be parallel to the normal reaction plane. The state of the polarization of the photon is described by a density matrix. A half integer spin (T^{JO}) can be determined from the angular distribution of the decay products, if particles of spin s decay with nonconservation of parity, according to the scheme $s \rightarrow 1/2 + 0^?$. Integer spin (T^{JO}) can also be determined from the angular distribution of the decay products if a particle of spin s decays according to the scheme $s\,0 + 0$ or $s\,0 + \gamma$. R.W.H.

N66-13138# Joint Publications Research Service, Washington, D. C.
APPROXIMATE METHOD OF CALCULATING THE ALPHA-RADIATION SPECTRA FROM THICK EMITTERS
V. P. Grigorov 8 Dec. 1965 11 p refs Transl. into ENGLISH from the Soviet monograph "Priblizhennyy Metod Raschetov Spektrov Al'fa-Izlucheniya Tolstykh Izluchateley" Moscow, Gosatomizdat., no. 44 p 1–9
(JPRS-33231; TT-65-33806) CFSTI: $1.00

An approximate method is described for calculating the spectra of pulse amplitudes in complex cases in which numerical integration is usually required. The emitter is assumed to have the shape of a disk, and the calculations are carried out in two cylindrical systems of coordinates: one is associated with the center of the disk, and the other with the volume element dv of the emitter. The reflection of alpha particles is disregarded, and the number of particles is found which escapes from dv and passes through the area element dS at the emitter surface. This method is shown to be especially useful in instances where the distribution is expressed by a complex function or where the analytic expression of distribution is unknown. C.T.C.

N66-13139# Los Alamos Scientific Lab., N. Mex.
A TABLE OF BINDING ENERGIES AND PARTICLE SEPARATION ENERGIES FROM A MASS LAW
Philip A. Seeger 27 Oct. 1965 107 p refs
(Contract W-7405-ENG-36)
(LA-3380-MS) CFSTI: $4.00

A table of approximately 10000 masses for nuclei with $22 \leq Z \leq 120$ and $22 \leq N \leq 184$ is presented. The mass law used is one developed by the author for application to the astrophysical problem of nucleosynthesis by rapid neutron capture. Author

N66-13149# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
NEUTRON RESONANCES OF YTTERBIUM ISOTOPES
Nai-Yang Wang, E. N. Karzhavina, A. B. Popov, Yu. S. Yazvitskii and Chi-Chuang Yao 1965 12 p refs In RUSSIAN
(JINR-P-2158) CFSTI: HC $1.00/MF $0.50

A slow neutron spectrometer was used to make the transmission measurements of the natural mixture of ytterbium and the radiative capture of ^{171}Yb, ^{172}Yb, ^{173}Yb, ^{174}Yb, ^{176}Yb, isotopes in the energy range up to 150 ev. The resonances were identified for the first time and their parameters were determined. The values of the strength function for ^{171}Yb and ^{173}Yb were obtained to be ($^{171}S_0 = (1.1 \pm 0.4) \cdot 10^{-4}$, $^{173}S_0 = (2.4 \pm 0.9) \cdot 10^{-4}$). The number of the observed levels in ^{171}Yb and ^{173}Yb allows the parameter σ in the Bethe formula, which shows a dependence of the level density on the excitation energy and on the compound nucleus spin ($\sigma = 2.5$), to be estimated. Author (NSA)

N66-13150# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
IMPLICATIONS OF THE ALGEBRA OF CURRENTS APPROACH TO HIGHER SYMMETRIES
C. Ryan 12 Oct. 1965 58 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-101)

The implications of the algebra of currents approach to higher symmetries is studied in the case of the SU(4) higher symmetry group. We discuss in turn the commutator algebra of integrated current operators and the manner in which it is employed to deduce results normally ascribed to a higher symmetry group. Various simple cases of the method are considered for the purpose of elucidating its hidden consequences. Particular attention is given to the role of the angular momentum in the whole procedure and to the question of using zero momentum as against nonzero momentum states.
Author

N66-13177# Stanford Univ., Calif. High Energy Physics Lab.
A DETERMINATION OF THE UPPER LIMIT TO THE ELECTRIC DIPOLE MOMENT OF THE ELECTRON AT HIGH MOMENTUM TRANSFER
R. E. Rand Apr. 1965 22 p refs Submitted for Publication
(Contract Nonr-225(67))
(HEPL-372; AD-471916)

A new limit on the electron's electric dipole moment at high momentum transfer has been determined by scattering 100 Mev electrons at 180 deg. from C^{12} nuclei. A full discussion of the theory involved and the experimental corrections due to multiple scattering, etc. is given. Assuming that the electron possesses no spurious magnetic moment, apart from the well established Dirac and anomalous moments, its electric dipole moment is 2.3×10^{-16} e-cm at a momentum transfer of 1.0 $Fermi^{-1}$. The result is consistent with Time-Reversal invariance in quantum-electrodynamics. Author (TAB)

N66-13182# Brookhaven National Lab., Upton, N. Y.
ON LINE DATA ANALYSIS OF HIGH ENERGY P-P SCATTERING EXPERIMENT
T. Fujii, E. Anderson, E. Bleser, R. Carrigan (Carnegie Inst. of Tech.), and Yu. D. Prokoshkin (Inst. of High Energy Phys.) 11 May 1965 15 p refs
(Contract AT(30-2)-GEN-16)
(BNL-9231; CONF-650510-9)

In order to carry out a series of p-p inelastic scattering experiments at high energy, a system was developed which is capable of analyzing the data from 12 digitized spark planes on line to PDP-6 computer. Some operational experiences obtained with this system are presented. NSA

N66-13191# Gosudarstvennyi Komitet po Ispolzovaniya Atomnoi Energii, Moscow (USSR).
UNITARY AND SPIN CONTENT OF SU(6) [UNITARNOE I SPINOVOE SODERZHANIE SUPERMUL'TIPLETOV SU 6]
A. M. Derelomov and I. A. Malkin 1965 41 p refs *Its* Rept. No. 337 In RUSSIAN; ENGLISH summary
(NP-15392) CFSTI: HC $1.00/MF $0.50

A method is developed which allows one to find a number of unitary multiplets with given spin in supermultiplets of the SU(6) group. The table of expansions of all the SU(6) representations given by the Young tableaux with the total number of boxes f = 3,6, and 9 is presented. The expansion of the SU (6) supermultiplet in the Wigner supermultiplets with the fixed value of hypercharge and spin of Λ-quarks: $SU(6) \supset SU(4) \otimes SU(2) \otimes U(1)$ was obtained. The table of expansion of the Kronecker product of the SU(6) simplest representations is also given. Author (NSA)

N66-13200# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
PRESENT STATUS OF WEAK INTERACTIONS
B. E. Marshak 15 Oct. 1965 43 p refs Presented at Tokyo Summer Inst. of Theoret. Phys., 13–17 Sep. 1965 and Kyoto Symp. on Elementary Particles, 21–23 Sep. 1965
(Contract AT(30-1)-875)
(UR-875-102)

In discussing weak interactions, developments in the following areas were reviewed: (1) SU_3 group, Cabibbo angle, and algebra of currents; (2) nonleptonic processes; (3) C P violation; and (4) intermediate vector boson and high energy neutrino experiments. Progress toward a unified understanding of semileptonic weak processes is described. The notation of the SU_3 group was developed so that the baryon current j_μ and g_μ could be expressed in terms of an SU_3 octet. Cabibbo's hypothesis was formulated, and tabular data are given on the comparison of Cabibbo's theory with experiment for predicting the transition probabilities for all known semileptonic decays. The current algebra method and its relationship to the quark model is also described. Several developments in the domain of nonleptonic weak interactions are discussed, including the discovery of the S wave triangular relationship. The question of C P violation is also examined, and several experiments and theories are summarized. The accomplishments of high energy neutrino experiments are listed, and the importance of determining whether the intermediate vector boson exists is pointed out. M.G.J.

N66-13223# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON METASTABLE SPECIES IN ATOMIC MOLECULAR BEAMS PRODUCED BY CHARGE TRANSFER Final Report
D. C. Lorents and J. R. Peterson 20 Sep. 1965 40 p refs
(Contract DA-31-124-ARO(D)-220; ARPA Order 553; Proj. Defender)
(AD-622272)

It is clear that excited atomic and molecular species play an important role in reentry phenomena. To understand and predict these phenomena, measured cross sections involving the excited species are required. A practical and general method of producing beams of metastable atoms and molecules is needed in order to measure these cross sections. For this use, near-resonant electron capture reactions are shown to produce excited neutral beams from ion beams with high efficiency. Total electron capture cross sections have been measured for the ions He^+ and Ar^+ in Rb and Cs in the energy range from 10 to 1500 eV. In these reactions, near energy resonances with the lowest metastable and allowed excited states of He and Ar occur, and capture into these states should be preferred. Cross sections ranging from 0.3 to 1.7×10^{-14} sq. cm were measured, the magnitude of which indicates that most of the reactions lead to excited states. A preliminary experiment with N_2^+ in Na gives strong indication of efficient production of excited N_2. Author (TAB)

N66-13234*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ATOMIC BEAM DETERMINATION OF THE CESIUM–CESIUM TOTAL SCATTERING CROSS SECTION
John W. Sheldon and Eugene J. Manista Washington, NASA, Dec. 1965 33 p refs
(NASA-TN-D-3160) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The cesium–cesium cross section is measured at three angular resolutions in the laboratory by total beam transmission through a scattering chamber containing cesium scattering atoms. The results show a marked dependence on laboratory angular resolution indicative of strong forward scattering. The forward scattering peak in the differential cross section is further evidenced by observations of broadening in the attenuated beam. The effective cross sections determined in the attenuations are correlated with an inverse r-sixth interaction and reduced to partial cross sections using the Berkling et al. tables. The partial cross sections are further analyzed within the framework of the semiclassical theory of Mason, Vanderslice, and Raw to obtain a method of extrapolation to zero angle in order to yield the total cross section corresponding to the assumed interaction $V(r) = -C/r^6$, where V(r) is the interaction potential, C is the dispersion energy constant, and r is the interatomic distance. The total cross section determined by this method for cesium–cesium is 2500 $Å^2$ at a relative velocity of 2.3×10^4 centimeters per second. From the value of the cross section an interaction strength of $C = 4080 \times 10^{-60}$ erg-cm^6 is calculated from the Schiff, Landau–Lifschitz relation. Author

N66-13246# Atomic Energy of Canada Ltd., Chalk River (Ontario).
CARIBOU, A PROGRAM FOR COMPUTING THE ISOTOPIC COMPOSITION OF NRX URANIUM METAL RODS
M. J. Halsall Aug. 1965 30 p refs
(AECL-2296; CRT-1187-B) CFSTI: HC $2.00/MF $0.50

This report is the second in a series of three (CRT-1187, Parts A, B and C) which describe calculations of the isotopic composition of irradiated NRX uranium metal rods. This part deals with the computer program which was used to integrate the burnup equations. The cross sections involved are calculated by methods described in detail in Part A, and the results obtained will be discussed in Part C. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N66-12179# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
CYCLOTRON DAMPING OF ION WHISTLERS: A METHOD FOR THE DETERMINATION OF ION TEMPERATURE
Donald A. Gurnett and Neil M. Brice (Carleton Univ., Ottawa) Sep. 1965 45 p refs
(Contract Nonr 1509(06))
(IS-65-34; AD-472140)

A method is presented of determining ion temperatures in the ionosphere from cyclotron damping of proton whistlers. For frequencies very close to the proton gyrofrequency in the long drawn-out tail of a proton whistlers, the amplitude of the proton whistler signal is observed to decrease very abruptly. Three effects, accessibility, collisional damping, and cyclotron damping, are investigated to explain the additional attenuation. For proton whistlers cyclotron damping is found to be the most important effect. A theoretical expression is derived for the attenuation of proton whistlers due to cyclotron damping. Using this theoretical expression a method is described for determining the temperature of protons in the plasma near the satellite from the duration of proton whistlers. Sample proton temperatures in the ionosphere are determined using VLF data from the Injun 3 and Alouette 1 satellites. (TAB)

N66-12242 # Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
STUDIES ON ELECTROMAGNETIC MEANS OF ADDING HEAT AND KINETIC ENERGY TO A GAS
Laurence R. Boedeker, James B. Coffin, Jr., Eugene E. Covert, and Charles W. Haldeman Wright-Patterson AFB, Ohio, ARL, Jun. 1965 269 p refs
(Contract AF 33(657)-7975)
(ARL-65-121; AD-62189)

The work completed during the three year contract period on electromagnetic means of adding heat and kinetic energy to a flowing gas stream is presented. Included are discussions of: the nonequilibrium RF plasma source; the magnetic induction accelerator including the effect of using magnetic core material in the accelerator coils; methods of coil design; numerical results for the one-dimensional flow in the traveling wave pump for various modes of operation; the unsteady axisymmetric flow near the inlet and the resulting velocity profiles; and methods of instrumentation employed to measure plasma properties. A brief discussion of the primary difficulties encountered is also presented. Author (TAB)

N66-12282# Yale Univ. Observatory, New Haven, Conn.
DEPARTURES FROM THERMODYNAMIC EQUILIBRIUM IN A HELIUM R.F. DISCHARGE
B. B. Chakraborty and L. Oster Wright-Patterson AFB, Ohio, ARL, Jul. 1965 20 p refs
(Contract AF 33(615)-2360)
(ARL-65-137; AD-621703)

Measurements by Crosswhite and Dieke (Am. Inst. Physics Handbook, 1957) of the visible lines of neutral helium emitted in a discharge that was excited by r.f. fields of 15 Mc frequency were used to deduce the population ratios of the various excited states. It is found that the highest states are strongly under populated with respect to lower excited states, that there is no significant difference between triplet and singlet populations, and that for any given principal quantum number the S state is highly overpopulated with respect to P and D states. It is concluded that the excitation takes place from the ground state, and that observed population ratios may possibly be used to predict the electron distribution function and/or the existence and amplitude of threshold resonances in the excitation cross-sections. Finally, it is pointed out that a discharge of the type discussed may act as a laser in a variety of spectral lines. Author (TAB)

N66-12298# Princeton Univ., N. J. Plasma Physics Lab.
THE STABILITY OF NEGATIVE V SYSTEMS
Russell M. Kulsrud Jul. 1965 17 p refs
(Contract AT(30-1)-1238)
(MATT-374)

Negative $\ddot{V}$ systems, which consider nonclosed lines of force for plasma stability against the interchange instability, are analyzed. It is pointed out that these systems are not closed in any physical sense, but are all straight systems with the closure obtained mathematically by identifying the two ends mathematically. The normal mode equations are derived for the interchange in this system including resistivity, and these equations are analyzed in the limit of large m. The results are applied to three cases: (1) zero resistivity for which

a critical β, β_c is given; (2) finite resistivty with $\beta < \beta_c$ and flow along lines neglected, $\sigma_R \tau >> 1$; and (3) finite resistivity with $\beta < \beta_c$ and flow along lines taken as infinitely fast. In each case an ordinary eigenvalue differential equation is derived: for case (1) the eigenvalue is β_c; for (2), it is σ_R; and for (3), no eigenvalue exists. These eigenvalues are estimated approximately by a Rayleigh–Ritz technique, and the different results are compared. M.G.J.

N66-12354# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE DEPENDENCE OF LONGITUDINAL PLASMA WAVE DAMPING AND GROWTH ON THE SHAPE OF THE VELOCITY DISTRIBUTION FUNCTION Scientific Report No. 255
Daniel P. Mioduzsewski 15 Nov. 1965 73 p refs
(Contract AF 19(628)-4014; Grant NSF GP-2914)
(AFCRL-65-638; AD-621913)

This paper uses the transform and perturbation theory approach for the problem of longitudinal plasma oscillations. The plasma dispersion relation is shown to be a natural consequence of both the initial value problem and the problem of forced oscillations. Distribution functions of the form

$$F_{O(v)} = A_{n1/(V-U)^{2n}} + \sigma^{2n}$$

where n=integer are investigated for both the single and double hump case. For the forced oscillations problem wave growth is obtained in space when the driving frequency is less than the plasma frequency. Wave growth is also described for the double hump distribution. Author (TAB)

N66-12397# Texas Univ., Austin.
KERR CELL PHOTOGRAPHY OF A DYNAMICAL DEUTERIUM PLASMA PRODUCED IN A 30 KILOJOULE THETA PINCH
Howard N. Roberts, Robert F. Gribble, and Arwin A. Dougal
Wright-Patterson AFB, Ohio, ARL, Aug. 1965 68 p refs
(Contract AF 33(657)-11073)
(ARL-65-171; AD-622088)

A 0.1 microsec Kerr cell shutter was employed in a photographic investigation of the space and time history of the luminous ring characteristic of the plasma current sheath in a high temperature, pure, dense, deuterium plasma formed in the θ pinch geometry. A method is proposed for obtaining rough estimations of relative electron densities from photographically recorded light intensities. The effect that different bias field intensities have on the beginning of the initial inward sweep of the luminosity is correlated with simple theory providing an indication that the current sheath and luminous ring are coincident during the initial inward sweep. Snowplow model energy calculations performed with the slope of the initial inward sweep from position versus time plots indicate ion energies from 40 to 100 ev agreeing within 10 per cent to computer calculations based on the theoretical considerations employed by the Hain-Roberts code. The noted dependence of the initial minimum radial position on reverse bias field intensity is interpreted to support the theory that the reverse bias field is 'trapped' by the current sheath. The leading edge of the observed luminosity is essentially the position of maximum particle density during the initial inward sweep. TAB

N66-12399# Kiruna Geophysical Observatory (Sweden).
ON THE INFLUENCE OF GRAVITY ON MAGNETOHYDRODYNAMIC WAVE PROPAGATION
W. Riedler Jun. 1965 23 p refs *Its* Sci. Rept.-4
(Contract AF 61(052)-619)
(AFCRL-65-688; AD-622222)

The influence of a uniform gravity field on magnetohydrodynamic wave propagation in an ideal medium with uniform magnetic field is discussed for two cases: (1) gravity force parallel to the magnetic field and (2) gravity force perpendicular to the magnetic field. TAB

N66-12435# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
SUMMARY OF PERFORMANCE OF THREE TYPES OF ARC HEATERS FOR MHD EXPERIMENTS. PERIOD 1961–64
J. Kenneth Richmond and Raymond Goldstein Mar. 1964 72 p refs
(TM-30)

As a result of the arc chamber development it may be stated that for heating inert gases the compact arc chamber, with a tungsten cathode, is superior to the other two in overall performance as well as reliability. It has been shown how its performance has been optimized, within the limitations of power supply imposed, to approach the required conditions for MHD experiments. At this point, it may be said to constitute a tool of research which may be relied upon. If, for any reason, higher pressure capability is desired, this has also been demonstrated, although at lower efficiencies. The performance reported is within the state of the art for efficiency of operation with argon at such pressures and flow rates, but higher temperatures can certainly be obtained by use of the restricted arc technique with considerable loss of temperature uniformity. The utility of the arc chamber depends, of course, on the design of a proper downstream plenum and nozzle. Author

N66-12445# Oak Ridge National Lab., Tenn.
THE ELECTRON–PHONON, ELECTRON–PLASMON, PLASMON–PHONON, AND PLASMON–PLASMON INTERACTIONS AND SOME INSTABILITIES THAT THEY LEAD TO
E. G. Harris (Tenn. Univ.) Nov. 1965 20 p refs
(Contract W-7405-ENG-26)
(ORNL-3871) CFSTI: $2.00

The electron–phonon and electron–plasmon interaction Hamiltonians previously found by Pines and Schrieffer are derived. Then a plasmon–phonon interaction Hamiltonian is derived. This is used to discusss a wave vector space instability found by Vedenov and Rudakov. Plasmons may interact by exchanging phonons. The plasmon–plasmon interaction Hamiltonian is derived. It is used to discuss the instability of a plasmon gas which was also found by Vedenov and Rudakov. Author

N66-12480# Polytechnic Inst. of Brooklyn, N. Y.
DEPT. OF AEROSPACE ENGINEERING AND APPLIED MECHANICS. OSCILLATIONS IN THE PLASMA SHEATH
Simon H. Schwartz Jul. 1965 23 p refs
(Contract Nonr-839(38); ARPA Order 529; Proj. Defender)
(PIBAL-880; AD-470753)

The behavior of the ion plasma sheath next to a wall is investigated under a sinusoidal-in-time perturbation of the potential of the wall. A collisionless sheath is assumed, and the ion density distribution is considered to remain at the steady state value, with only the electron distribution being perturbed. The collisionless macroscopic plasma equations are solved by a perturbation procedure, using an exact equation for the steady state potential distribution. A second order differential equation which is linear, but which has variable coefficients is obtained for the perturbation. This equation is transformed into the form of a wave equation with variable propagation constant so that the analytical behavior can be deduced. One observes that above a certain range of frequencies, but below

the plasma frequency of the uniform plasma, the perturbation may propagate over a finite region which may begin away from the wall. A numerical integration of the equation is performed, using an asymptotic approximation in order to obtain the boundary conditions. The predicted oscillations are seen to occur, and two resonances in the sheath are found at frequencies below the plasma frequency. Author (TAB)

N66-12481# Princeton Univ., N. J. Plasma Physics Lab.
OPTICAL WINDOWS FOR PLASMA RESEARCH
David H. Mulaney [1965] 13 p refs Presented at 1965 Symp. on Eng. Problems of Controlled Thermonucl. Res., Lawrence Radiation Lab., Livermore, Calif., 4–7 May 1965
(Contract AT(30-1)-1238)

High-vacuum techniques of sealing ultraviolet transmitting materials to metals are discussed. Materials, brazed seals, mechanical seals, and glass-to-metal seals are considered. Also, tests performed and the results of these tests for various sealing techniques are summarized. The only satisfactory high-vacuum seal to lithium fluoride was found to be silver chloride sealing. These seals can be heat cycled to 300° C at least 10 times with proper care. Baking above 300° C caused excessive deformation of the LiF crystal and a resulting vacuum leak. Ram seals up to four-inch diameter were tested. These can be heat cycled to 450° C at least 10 times. Active hydride brazing to platinum seals were found to be reliable and are not expensive in small sizes up to one-inch diameter. For larger diameter windows brazing techniques with a backup ring or the ram seal were found to be satisfactory. Quartz was found to be the most difficult window to seal to metal. The graded seal method is satisfactory but is usually too long to be used on the equipment under consideration. E.E.B.

N66-12483# Montreal Univ. (Quebec). Dept. of Physics.
PLASMA PHYSICS LABORATORY ANNUAL REPORT [RAPPORT ANNUEL DU LABORATOIRE DE PHYSIQUE DES PLASMAS]
Oct. 1965 56 p refs In FRENCH; ENGLISH summary
(Rept.-2) CFSTI: HC $3.00/MF $0.50

Several research projects are described which deal with the development of laboratory tools for studying plasmas with negative ions such as single and double probes and the radio frequency probe. Each project is closely connected with a parallel theoretical study. The studies of plasmas with negative ions also include an experiment on the Townsend ionization and attachment coefficients in mixtures of chlorine and argon. A study of diffusion of charges in a plasma containing negative ions is also being conducted. A project is in progress to measure the structure and motion of striations in a gas discharge by microwave techniques. A theoretical study is being conducted on the Tonk–Dattner resonances. A basic study was undertaken to determine the electromagnetic properties of a plasma in the presence of negative ions. A project on the development of a radio frequency velocity selector for electrons is also in progress and experiments are being conducted with an electron gun to establish the performance of this probe. R.N.A.

N66-12488# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INTERACTION BETWEEN A SOURCE FLOW OF PLASMAS AND A MAGNETIC DIPOLE
K. T. Yen Oct. 1965 28 p refs
(R65SD56)

Interaction between a source flow which starts with a uniform velocity from the surface of a sphere and a magnetic dipole is considered. A perturbation analysis has been performed with a ratio λ between the magnetic field energy and the kinetic energy of the flow as the perturbation parameter. This perturbation procedure is applicable to the problem of interaction between the solar wind and the sun's general magnetic field, for which this ratio is smaller than one. With a source flow as the starting point, solutions for the first-order perturbations to the magnetic field and the source flow have been obtained. These results show how the dipole magnetic field is drawn out by the source flow, and how the flow is distorted by the action of the magnetic field and becomes nonuniform. The nonuniformity of the source flow is of the order of λ^3, a small quantity (approximately .01) for the solar wind. Author

N66-12491 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MEASUREMENT OF THE $v \times B$ BEHIND MAGNETO-HYDRODYNAMIC SHOCK WAVES IN THE TRANSVERSE MAGNETIC FIELD
L. Rothhardt *In its* Monthly Reports of the Acad. of Sci. in Berlin 11 Jun. 1965 p 1–7 refs (See N66-12490 03-23)

Experiments were conducted with a hydrogen plasma gun which uses inductively produced cylindrical converging shock waves in order to create a pulsating high pressure that then produces a hydrodynamic shock wave. Since the material carried along behind the path of the shock wave is electrically conductive, measurements were made of the $v \times B$ EMF and the results are discussed. R.N.A.

N66-12496# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
A FAST INVERSE PINCH SHOCK TUBE FOR PLASMA SHOCK WAVE STUDIES
George C. Vlases 7 Oct. 1965 22 p refs
(Contract DA-31-124-ARO(D)-139)
(JILA-49)

A device for studying mhd shock waves has been designed and built. At initial pressures above 200 μ the performance of the machine is essentially that predicted by theory. Below this pressure, the shock speeds have been less than those predicted for reasons believed to be associated with poor breakdown characteristics. Evidence has been obtained that separation of shock and piston, a primary goal of the experiment, has been achieved for moderate axial magnetic field strengths. Early experiments on ionizing mhd waves have verified the change in character from ordinary (gas dynamic) behavior to mhd behavior of the wave as evidenced by magnetic field compression beginning at 5 μs/cm. Author

N66-12498# Princeton Univ., N. J. Plasma Physics Lab.
ION HEATING IN THE MODEL C STELLARATOR
S. Yoshikawa, R. M. Sinclair, and M. A. Rothman Oct. 1965 22 p refs
(Contract AT(30-1)-1238)
(MATT-373)

Ion cyclotron resonance heating is applied to C stellarator plasmas with the hope of understanding the anomalous particle loss process and to determine whether the rate of particle loss is proportional to plasma temperature T, as suggested by investigations performed with ohmically heated plasmas and afterglows. Work with ion cyclotron wave heating in the Model C stellarator, the apparatus and diagnostic equipment, and experiments to improve the coupling of waves to the plasma are described. Ion and electron heating is discussed and

theoretical limitations are described. Experiments with plasmas having two ion species are also described. Particle confinement between local magnetic mirrors and in the stellarator as a whole is discussed. R.N.A.

N66-12515# Elcon Lab., Inc., Peabody, Mass.
HIGH POWER MAGNETICALLY CONFINED PLASMA DUPLEXER Quarterly Report No. 8, 1 Mar.–31 May 1965
Edwin Langberg and William Ghen [1965] 37 p
(Contract DA-36-039-AMC-02364(E))
(Rept.-8; AD-621745)

Three methods of reducing the recovery time of the magnetically confined plasma duplexer are investigated. One method, the use of a plasma tuned cavity, is partially successful, but is too complicated to be practical. A second method using d.c. sweeping electric fields is unsuccessful. A third method, using thin dielectric fibers to reduce the average ambipolar diffusion distance in the plasma is a satisfactory compromise solution to the problem of achieving an acceptable recovery time and having a very effective confining magnetic field. Author (TAB)

N66-12529*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLE OF CONDUCTIVITY IN HYDROMAGNETIC STABILITY OF PARALLEL FLOWS
Philip R. Nachtsheim and Eli Reshotko (Case Inst. of Tech.) Washington, NASA, Dec. 1965 25 p refs
(NASA-TN-D-3144) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The role of the electrical conductivity in the stability of magnetohydrodynamic channel flow with parallel magnetic field is examined through exact numerical solution of the pertinent sixth-order system of disturbance equations throughout an extended range of magnetic Reynolds numbers. The results obtained indicate that the conductivity of the fluid acts as a stabilizing agent, as long as it is small, and as a destabilizing agent, if it is large. It is concluded that the conductivity reverses its role as a stabilizing agent at a magnetic Reynolds number of order unity. Examination of the contributions to a disturbance energy balance equation shows that the conductivity acts as a destabilizing agent by setting up a time-independent Maxwell stress that has the same sign as the vorticity of the basic flow. Author

N66-12532*# General Dynamics Corp., San Diego, Calif.
CYCLOTRON WAVES IN A COLLISIONLESS PLASMA
C. B. Wharton and J. H. Malmberg Washington, NASA, Dec. 1965 14 p refs
(Contract NAS7-275)
(NASA-CR-348) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Experimental studies of plasma waves in a 2 meter long collisionless plasma column, over the frequency range 30 to 520 Mhz, are reported. Special attention is given to the frequencies neighboring the electron cyclotron frequency ω_b. At least three (and perhaps more) distinct waves having resonances at or near ω_b are found. Two waves lie above the cyclotron frequency. One has a velocity greater than that of light and is a forward wave, apparently an electromagnetic waveguide mode, perturbed by the plasma. The other is a slow, backward wave, having a propagation cutoff at the upper hybrid frequency $\omega_{uh} = (\omega_b^2 + \omega_p^2)^{1/2}$, with a dispersion curve resembling that of the C_{01} cyclotron wave. This wave is heavily damped in space, typically 10 to 20 dB per wavelength. The third wave is a slow forward wave, lying below ω_b and resembling a whistler. It is only moderately damped. The measured dispersion curves of these waves are presented, and their relation to the predictions of theory is discussed. Author

N66-12540# RAND Corp., Santa Monica, Calif.
WAVE PROPAGATION IN INHOMOGENEOUS ISOTROPIC HOT PLASMAS
H. Unz Sep. 1965 28 p refs
(P-3178-1; AD-621457)

The three dimensional wave equations for waves propagating in inhomogeneous, isotropic, hot compressible plasmas are derived from the macroscopic, linearized electromagneto-plasma-gas-dynamics equations. Particular cases are discussed and compared with previous results. Author (TAB)

N66-12566# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF CONTROLLED NUCLEAR FUSION AND HIGH-TEMPERATURE PLASMA PHYSICS
L. A. Artsimovich 9 Aug. 1965 25 p Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 17, no. 4, 1964 p 269–278 Presented at 3d Intern. Conf. on Peaceful Uses of Atomic Energy, Geneva, 1964
(FTD-TT-65-961/1+2; AD-620864)

Experimental and theoretical developments in the control of nuclear fusion reactions as plasmas of temperatures of hundreds of millions of degrees are discussed. Thermal insulation by means of magnetic fields is discussed. Successful control of nuclear fusion would allow the use of deuterium and tritium as nuclear fuel for power applications. TAB

N66-12580# Princeton Univ., N. J. Plasma Physics Lab.
BALLOONING INTERCHANGE INSTABILITIES OF MAGNETIZED PLASMAS UNDER GRAVITATIONAL FIELDS
S. Yoshikawa Sep. 1965 22 p refs
(Contract AT(30-1)-1238)
(MATT-358)

The relation between the resistive ballooning mode and the universal type instability with gravitational field (simulating the magnetic field curvature) is discussed. It is shown that under appropriate assumptions, the instability of the universal type is an extension of the resistive ballooning mode if we replace the collision frequency in the resistive ballooning mode by the effective kinetic collision frequency $k_z v_e$. The relative importance of these ballooning instabilities to toroidal plasmas is discussed. Author

N66-12591# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF ELECTRODE GEOMETRY OF A COAXIAL GUN ON THE PARAMETERS OF PLASMA CLOTS
A. O. Kalmikov, V. G. Marinin et al 13 Aug. 1965 7 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 9, 1964 p 1023–1025
(FTD-TT-65-651/1+2+4; AD-620822)

A plasma accelerator was investigated, which consists of two coaxial cylinders of stainless steel. Clots obtained from this source were investigated with the aid of a mass-spectrograph with an electric field intensity of 20 kv. The experimental results show that the density and velocity of plasma clots are not at all affected by the material of the electrodes, nor by the parameters of the discharge stakes (with the exception of capacitor capacities). The change in geometric dimensions (e.g., changes in length of central electrode) actually affects the velocity, number of fast ions and magnitude of total energy of the clot. The results of this investigation confirm the conclusion that the mechanism of accelerating the clots in a coaxial source differs from the one proposed up to this time. TAB

N66-12612*# Space Sciences, Inc., Waltham, Mass.
THE DEVELOPMENT OF A SOURCE OF VACUUM ULTRAVIOLET AND SOFT X-RADIATION Final Report
M. Doctoroff and J. Proud Jun. 1964 54 p
(Contract NAS5-3365)
(NASA-CR-68225; SSI-FR-91) CFSTI: HC $3.00/MF $0.50 CSCL 20I

This report describes the successful development of an intense pulsed source of vacuum ultraviolet and soft x-radiation. The technique employed involves the compression of a helium plasma whose temperature is believed to be near 50 electron volts (=kT). Data are presented which show the shape of the x-ray pulse, and the spectra which can be expected from a finished prototype of the source being fabricated for delivery to Goddard Space Flight Center. Author

N66-12617# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT STATES WITH ANISOTROPIC DISTRIBUTION FUNCTION IN RAREFIED RELATIVISTIC GAS
G. M. Zaslavskiy and S. S. Moiseyev 28 May 1965 9 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 1, 1962 p 20–24
(FTD-TT-65-100/1; AD-620814)

To the number of gas states, in which anisotropic velocity distribution is possible, are included in particular, plasma in a magnetic field at neglected collisions and beam of charged particles, passing through the plasma. Study of such states is of particular interest for relativistic gas, where the length of free run of the particles is much greater than in nonrelativistic gas of very same density, and losses in energy particles during radiation substantially affect their movement. Author (TAB)

N66-12662# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ATOMIC ENERGY Selected Articles
28 Jun. 1965 44 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 17, no. 3, 1964 p 177–184, 185–188, 211–215, 217–219
(FTD-TT-65-162/1+2+4; AD-621006)

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2. ON THE MECHANISM OF X-RAY AND NETURON RADIATION OF POWERFUL PULSED DISCHARGES M. D. Rayzer and V. N. Tsytovich p 16–24 refs (See N66-12664 03-25)
3. MAGNETIC FIELD OF CORKSCREW CONFIGURATION, GROWING ALONG THE RADIUS Yu. V. Martynenko and R. I. Sobolov p 25–34 refs (See N66-12665 03-25)
4. THE PASSING OF β-PARTICLES THROUGH A SUBSTANCE K. K. Aglintsev and V. P. Kasatkin p 35–40 refs (See N66-12666 03-25)

N66-12663 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF A TRANSVERSE MAGNETIC FIELD ON A TOROIDAL DISCHARGE IN AN INTENSIVE LONGITUDINAL MAGNETIC FIELD
B. M. Grigorovich and V. S. Mukhovatov *In its* Atomic Energy 28 Jun. 1965 p 1–15 refs (See N66-12662 03-25)

The effect of a transverse magnetic field on a toroidal discharge in an intensive longitudinal magnetic field, was investigated. It was revealed, that at a definite displacement value of the cord, oscillations on the oscillograms of electrical characteristics of the discharge have a minimum amplitude, and mean conductivity of plasma reaches a maximum. It was shown, that the effect of the transverse component of the magnetic field can be explained principally, on the basis of ideas about the equilibrium of the plasma cord within the conductive housing. Author

N66-12664 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE MECHANISM OF X-RAY AND NEUTRON RADIATION OF POWERFUL PULSED DISCHARGES
M. D. Rayzer and V. N. Tsytovich *In its* Atomic Energy 28 Jun. 1965 p 16–24 refs (See N66-12662 03-25)

Based on the statistical mechanism of particle acceleration by plasma waves, a qualitative explanation of certain characteristics of hard radiation of powerful pulsed discharges is presented. Consideration is given to distinguishing features, the method by which plasma waves are generated, discharge in a mixture of two gases, and acceleration discontinuities. C.T.C.

N66-12665 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC FIELD OF CORKSCREW CONFIGURATION, GROWING ALONG THE RADIUS
Yu. V. Martynenko and R. I. Sobolov *In its* Atomic Energy 28 Jun. 1965 p 25–34 refs (See N66-12662 03-25)

A simplified examination is given of the combined magnetic field for systems with four, six, and eight conductors applicable to the magnetron injection method of maintaining plasma in an adiabatic trap. It is assumed that the stabilizing field is created by currents which flow along the system of conductors, representing infinitely long and thin strips situated on the surface of a round cylinder of singular radius. Each strip occupies an arc of circumference with central angle α, and currents in neighboring strips are directed in opposite directions. C.T.C.

N66-12666 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PASSING OF β-PARTICLES THROUGH A SUBSTANCE
K. K. Aglintsev and V. P. Kasatkin *In its* Atomic Energy 28 Jun. 1965 p 35–40 refs (See N66-12662 03-25)

Experimental investigations of passing beta particles through filters of a tissure equivalent substance are described. The angular distribution was determined for particles emitted by Pm^{147}, W^{185}, Tl^{204}, and P^{32}. Schematics and graphs are given along with the calculations. C.T.C.

N66-12698# Rand Corp., Santa Monica, Calif.
RADIATION SMOOTHING OF SHOCKS
M. G. Kivelson and J. A. Welch, Jr. Aug. 1965 42 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4683-PR; AD-620835)

The structure of a steady-state shock temperature profile in a fully-ionized ideal gas in the presence of a magnetic field is examined. It is pointed out that many of the important qualitative features of the temperature profile can be obtained in a simple way from a nomogram whose use is described. The customary introduction of a simplifying assumption (such as

the Milne-Eddington approximation) relating the radiation pressure to the radiation energy flux is postponed to indicate which predictions are clearly independent of the approximation and which features may be a consequence of it. The thermal equilibrium of the electrons with the ions in the plasma is considered, and a parameter which measures the importance of the deviation from equilibrium is given. Author (TAB)

N66-12841# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE KINETIC THEORY OF THE BOUNDARY LAYER BETWEEN A RAREFIED PLASMA AND A MAGNETIC FIELD

Yu. S. Sigov 30 Aug. 1965 20 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 6, 1964 p 1065–1077
(FTD-MT-65-152; AD-621771)

The work refines the mathematical formulation of the general steady-state problem about the structure of a self-consistent electromagnetic field in the plane 'plasma magnetic field' transition layer, and presents a qualitative analysis of solutions. Under the assumption of absence of 'captured' particles, the law of decrease of the self-consistent field is found. It is shown that in this case, for a broad class of distribution functions of particles between homogeneous plasma and electromagnetic field, there is realized a sharp boundary. An attempt is made to formulate clearly all physical assumptions and mathematical restrictions, while preserving that order in which they appear in a natural manner in theory. TAB

N66-12843# United Aircraft Corp., East Hartford, Conn. Research Labs.

NON-EQUILIBRIUM IONIZATION USING ELECTROSTATIC PROBING TECHNIQUES Final Report, Mar. 1, 1963–Feb. 28, 1965

R. H. Bullis 26 Apr. 1965 39 p refs
(Contract AF 49(638)-1221)
(D-920072-6; AD-621276)

Research was conducted to determine the electron energy distribution in the cesium plasma in an arc-mode thermionic converter and to determine the changes in this distribution produced by the presence of a highly inert gas background pressure. Electrostatic probes were used to measure various plasma properties, such as electron energy distribution, electron number density, and plasma potential. Calculations were made of the plasma production and loss rates. A bibliography of the publications resulting from this work and reprints of the most recent papers covering portions of the research are included. Author (TAB)

N66-12907# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

FORMATION OF COMPRESSION WAVES IN A COLLISION-FREE PLASMA

K. T. Yen and Paul Gordon Nov. 1965 40 p refs
(R65SD57)

The time development of compression waves in a collision-free plasma produced by an electric field applied at the plasma boundary is studied by numerical integration. Coupled hydrodynamic and Maxwell equations are used. It is shown that this initial-value problem can be solved in a mathematically rigorous manner, provided the displacement current is retained in the Maxwell equation. Details of the formation of the compression waves and profiles of various physical quantities have been obtained from an IBM-7094 computer. The disturbances in the form of maxima of these quantities are found to propagate with different speeds. The plasma density at the boundary decreases with time, and the time for it to drop to nearly zero depends on the ratio between the initial values of the gas and magnetic pressures. For a zero-temperature plasma, this ratio is zero and the plasma will separate from the boundary immediately. The physical and mathematical difficulties of the problem for zero-temperature plasmas are discussed. Author

N66-12908# California Univ., Livermore. Lawrence Radiation Lab.

THEORY OF THE ELECTROSTATIC PROBE AND ITS IMPROVED USE AS A DIAGNOSTIC TOOL

Laurence S. Hall and Robert P. Freis 29 Jul. 1965 14 p refs
(Contract W-7405-ENG-48)
(UCRL-12480; CONF-650806-3)

We consider the steady-state electrostatic probe problem in a theoretical model similar to that of Bernstein and Rabinowitz, but differing in that our methods are applicable to systems in which the undisturbed distributions of attracted and repelled particles at infinity are arbitrary. Computations are made in which these distributions are both Maxwellian (but at different temperatures). The results for cylindrical probes are presented in graphical form in a manner which permits the simple determination of unknown plasma parameters in terms of easily measured properties of empirical current-voltage characteristics. Author

N66-12949# Lockheed Missiles and Space Co., Sunnyvale, Calif.

CYCLOTRON RADIATION OF IONS IN PLASMA

V. I. Pistunovich and V. D. Shafranov [1965] 11 p refs Transl. into ENGLISH from Nucl. Fission (Moscow), v. 1, 1961 p 189–194

The intensity of the radiation of fast ions in a cold plasma is determined. This problem arose in connection with the observation of resonance peaks in the electrical field intensity at the cyclotron ionic frequency and its overtones on the Ogre apparatus in specific regimes. Although the observations were not conducted in the wave zone, it is natural to expect that the dependence of the number of observed peaks on the density of the cold plasma, which was detected in experiment, should be reflected in the intensity of the radiation as well. Computations presented show that the radiation intensity of fast ions in a cold plasma increases as the plasma density increases. The character of the radiation intensity distribution over the harmonics also depends on the plasma density. As the density increases a shift in the maximum of the radiation intensity occurs towards the high overtones. Both of these circumstances can be used for diagnostic purposes to determine the plasma density. It should be kept in mind that the presented formulas determine the radiation intensity at large ranges R as compared with the radiated wavelength v. Under laboratory conditions the requirement $R >> v$ is satisfied (if the antenna is in the plasma) for a comparatively high plasma density. R.N.A.

N66-12964*# Stanford Univ., Calif. Inst. for Plasma Research.

ARGON PLASMA TRANSPORT PROPERTIES

R. Stephen de Voto Feb. 1965 59 p refs
(Grant NsG-299-63)
(NASA-CR-68297; SU-AA217; SUDAER-217) CFSTI: HC $3.00/MF $0.50 CSCL 20I

The transport properties of equilibrium argon plasma have been computed for pressures of 1, 10, 100, 760, and 1900 mm Hg from 5000° to 20000° K. In addition to the usual viscosity and thermal conductivity, the thermal and multicomponent diffusion coefficients have also been computed. Two problems not occurring in computations of properties of un-ionized gases are examined. The first concerns the rate of convergence of the approximations to the transport coefficients. It is found that at least the third approximation to the thermal conductivity must be used down to very low degrees of ionization to ensure the accuracy of the results. Very slow convergence is also observed for the electron-atom, atom-electron and electron-ion diffusion coefficients at very low degrees of ionization. The source of this behavior is apparently the Ramsauer minimum in the electron-argon atom cross sections. The second problem occurs in the charged particle cross sections. In the present report the shielded Coulomb potential is used to bypass the divergence occurring in this cross section when the unshielded potential is used. Inclusion of terms of order unity in these cross sections increases the transport coefficients by appreciable amounts. Computations of electrical conductivity are also compared with some measured values here. Author

N66-12979*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
ESTIMATES OF NONEQUILIBRIUM IONIZATION PHENOMENA IN THE INVISCID APOLLO PLASMA SHEATH
M. G. Dunn, J. W. Daiber, J. A. Lordi, and R. E. Mates Sep. 1965 64 p refs
(Contract NAS5-3976)
(NASA-CR-68309; CAL-A1-1972-A-1) CFSTI: HC $3.00/MF $0.75 CSCL 20I

Nonequilibrium ionization estimates were made for the plasma sheath of an Apollo-type body entering the earth's atmosphere at 30,000 ft/sec at an angle of attack of 20°. Results are presented for altitudes of 200,000 ft and 250,000 ft. Charged species of N_2^+, O_2^+, NO^+, O^+ and e^- were evaluated by a chemical model allowing three-body combination reactions as well as ion-atom-exchange reactions. Nonequilibrium species concentrations for both the neutral and the charged particles were considered. The dominant electron-depletion reactions were: $NO^+ + e^- \rightarrow N + O$, $N_2^+ + e^- \rightarrow N + N$, $N^+ + e^- + e^- \rightarrow N + e^-$, and $O^+ + e^- + e^- \rightarrow O + e^-$. Electron density contours in the forebody and near the afterbody region were established for altitudes of 200,000 ft and 250,000 ft. Corresponding values for an altitude of 250,000 ft were approximately 50 times less. Electron density distributions and collision frequency distributions for two selected paths through the plasma sheath showed a high incident rate in the inviscid flow-field. Propagation attenuation of one-dimensional plane waves along these two paths established exceeding communication difficulties for carrier frequencies in the range of 1 to 10 Gc. G.G.

N66-13003# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ELECTRON RECOMBINATION IN A PLASMA EXPANDING INTO VACUUM
N. M. Kuznetsov and Iu. P. Raizer [1965] 14 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 4, 1965 p 10-20

A monatomic heated ionized gas which expands spherically and symmetrically into a vacuum was investigated, with specific interest in the later, inertial stage of the dispersion. The time change in the degree of ionization at low temperatures after the violation of ionization equilibrium and the cessation of ionization processes was also considered. It was found that all the computations were made under the assumption that the energy which transforms initially into radiation during spontaneous radiative transitions in excited atoms depart completely from the gas cloud and are, therefore, lost for the gas. The question of the diffusion of resonant radiation depends essentially on the size and density of the gas cloud and on the character of the spectrum line broadening, which determines the height of the absorption line, i.e., the length of the resonant radiation path. R.R.D.

N66-13016*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VOLUME AND SURFACE INSTABILITY IN SLIDING PLASMAS
S. P. Talwar Washington, NASA, Dec. 1965 20 p refs
(NASA-TN-D-3051) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The electrostatic instability arising due to a tangential discontinuity of velocity in two semi-infinite, homogeneous regions of a cold and collisionless plasma subject to a uniform magnetic field is investigated by use of two fluid equations. A general dispersion relation is derived allowing for interstreaming of charged particles in each region in addition to a slippage of one region over the other. Special cases are then discussed and the criteria for stability, monotonic instability and growing wave instability are derived. Author

N66-13022*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONADIABATIC PARTICLE LOSSES IN AXISYMMETRIC AND MULTIPOLAR MAGNETIC FIELDS
J. Reece Roth Washington, NASA, Dec. 1965 76 p refs
(NASA-TN-D-3164) CFSTI: HC $3.00/MF $0.75 CSCL 20I

This report contains an analytical and experimental study of the nonadiabatic behavior of a single nonrelativistic charged particle in a magnetic field. Two magnetic field geometries were considered; an axisymmetric magnetic mirror, which was investigated by both analytical and experimental means, and a minimum-B configuration formed by the superposition of a multipolar (Ioffe) magnetic field on an axisymmetric magnetic mirror, which was studied only by analytical means. The nonlinear equations of motion for a charged particle in these magnetic field configurations were solved for 10^5 sets of initial conditions on a high-speed computer. A particle was considered to be nonadiabatic if its "adiabatic invariant" $M_4 = v_\perp^2/B$ varied by more than 5 percent during a single interaction with the magnetic mirror in question. By defining suitable dimensionless similarity parameters, it was found possible to summarize the computer results in a single analytical expression, which predicts the conditions under which nonadiabatic behavior will be observed. This similarity relation is a useful substitute for a closed-form solution to the nonlinear and nonholonomic mathematical problem, and may be used as a basis for correlating experimental data. Author

N66-13027# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
THE EFFECT OF WALL CONDUCTANCE ON MAGNETOHYDRODYNAMIC FLOW THROUGH FINITE CROSS SECTION CHANNELS Report No. 1
Richard R. Gold Nov. 1965 31 p refs
(SSD-50050R)

A detailed analysis of fully developed magnetohydrodynamic flow through rectangular and circular channels is presented for nonzero finite values of the uniform wall conductance, ϕ. In particular, perturbation solutions are derived

for small and large values of ϕ for the rectangular channel and small values of ϕ for the circular geometry. These results are combined with existing exact and approximate calculations in a semigraphical procedure to obtain the ratio of mean velocity to pressure gradient as a function of arbitrary values of Hartmann number and ϕ. Of particular interest is the substantial difference found between the present results when $\phi << 1$ and previous calculations for $\phi = 0$. Author

N66-13105# Oak Ridge National Lab., Tenn.
A STUDY OF THE PROPERTIES OF IONIC SOUND WAVES
W. D. Jones and I. Alexeff 3 Aug. 1965 24 p refs
(Contract W-7405-ENG-26)
(ORNL-P-1557; CONF-650806-5)

Extensive studies of the properties of ionic sound waves were made using a time-of-flight technique. The waves were propagated in collisionless plasmas formed by rare-gas discharges. The following plasma and wave properties were investigated: wave velocity dependence upon ion mass; frequency and electron temperature; wave reflection; wave interference phenomena; wave gas damping; wave focusing; plasma sheaths; plasma ion temperature; and the adiabatic compression coefficient of the electron gas. Author

N66-13122# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
LAMINAR MHD CHANNEL ENTRANCE FLOWS
C. W. Tan Aug. 1965 24 p refs Submitted for Publication
(RM-292J)

Velocity fields, boundary layer development, and friction factors are analyzed for an entrance MHD flow of an incompressible and electrically conducting fluid. A two-dimensional constant area channel is used for flow, and the momentum–integral method with an appropriate Hartmann-like velocity distribution is used in the analysis. Laminar, steady, low magnetic Reynolds number flow is assumed, with magnetic and electric fields mutually perpendicular to the flow direction. Closed form solutions are obtained, and variation of the free stream velocity in the flow direction is fully accounted for. Close agreement with the results found by other investigators using other techniques is obtained. C.T.C.

N66-13196# Sydney Univ. (Australia).
SOME EXPERIMENTAL OBSERVATIONS OF THE ATTENUATION OF ALFVEN WAVES IN A LABORATORY PLASMA
Ian G. Brown May 1965 26 p refs
(ER-15; NP-15357) CFSTI: HC $2.00/MF $0.50

An experiment is described in which the velocity and attenuation of torsional, azimuthally symmetric hydromagnetic waves are measured in a hydorgenous plasma, from low frequencies where ion-neutral collisions are unimportant to the wave damping to frequencies where such collisions profoundly affect the damping. A theory including both ion–electron and ion–neutral collisions is outlined, and the attenuation results compared to the theoretical values. An estimate is made, from the frequency dependence of the attenuation, of the hydrogen ion–atom collision cross section for momentum transfer. Author (NSA)

N66-13205# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LONG HIGH-PRESSURE ARCS
Ye. S. Borovik, Yu. R. Knyazev, and R. V. Mitin 8 Jul. 1965 16 p refs Transl. into ENGLISH from Fiz. Plazmy i Probl. Upravlyaemogo Termoyadern. Sinteza, Akad. Nauk Ukr. SSR, Fiz.-Tekhn. Inst. (Kiev), Issue 2, 1963 p 296–306
(FTD-MT-64-478; AD-619475)

Experiments were made with long high-pressure arcs to study possibility of heating of a dense plasma up to temperatures of several tens of thousands of degrees with relatively small expended power. Conclusions are: rotation of gas surrounding arc makes it possible to obtain long stable arcs in range of pressures of helium from 1 to 100 atm; with length of arc greater than 5 cm, larger part of energy is released directly into arc column; at pressures higher than 20 to 30 atm, losses due to radiation are decisive in balance of energy; investigation of interrelation of pressure, voltage gradient and current in arc make possible calculation of such arc parameters as radius of channel of arc, temperature of plasma, degree of ionization of plasma. TAB

N66-13222# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
VARIABLE CONDUCTIVITY, FULLY DEVELOPED MHD CHANNEL FLOW
Paul Clement Kieffer (M.S. Thesis) Jun. 1965 101 p refs
(GAM-65B/ME/65-4; AD-622036)

Fully developed MHD channel flow was studied for several conductivity profiles to determine the effect of nonuniform conductivity on the flow variables. The velocity profiles, volume rate of flow, and shear at the wall were investigated. If the conductivity only varies near the wall, the flow is moderately affected. If the conductivity in the central portion of the channel varies, significant changes (as much as 300% error based on uniform conductivity results) can occur. Variable conductivity has its greatest effect when the conductivity increases from the centerline to the walls. Inflection points can occur in the velocity profiles when the conductivity decreases from the centerline to the walls.
Author (TAB)

N66-13294*# National Aeronautics and Space Administration, Washington, D. C.
ACCELERATION OF A PULSATING PLASMA SLUG [USKOREYIYE PUL'SIRUYUSHCHEGO PLAZMENNOGO SGUSTKA]
P. M. Kolesnikov Dec. 1965 12 p refs Transl. into ENGLISH from Magnitn. Gidrodinam. (Riga), v. 1, 1965 p 73–79
(NASA-TT-F-9452) CFSTI: HC $1.00/MF $0.50 CSCL 20I

This paper deals with the acceleration of a pulsating plasma slug in a high current pulse accelerator. The pulses of the plasma slug are caused by the magnetic pressure forces of interior currents and the gas-kinetic pressure forces in the slug. With an increase in gas-kinetic pressure these pulses decrease and can be absent altogether. In this case, only an expansion of the slug occurs. Strong pulses, sharply changing the system's inductance, can cause an overloading of the system and the appearance of instability of the pinch type. Also, the movement of the slug's center of mass due to the force of magnetic pressure is examined. Author

N66-13295*# National Aeronautics and Space Administration, Washington, D. C.
THE PHYSICS OF VERY HOT PLASMA [FIZIKA OCHEN' GORYACHEY PLASMY]
L. A. Artsimovich Dec. 1965 18 p Transl. into ENGLISH from Priroda (Moscow), no. 4, 1965 p 17–24
(NASA-TT-F-9457) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The importance of plasma physics in the study of controlled thermonuclear fusion and magnetohydrodynamics is discussed. The interaction of particles in high-temperature plasmas, collisionless gases, magnetic traps, and plasma instability are considered. Also, the successful production of plasmas with temperature of a million degrees and with a density of the order of 10^{15} to 10^{16} particles per cc is mentioned. E.E.B.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-12246*# Pittsburgh Univ., Pa. Space Research Coordination Center.

OPTICAL STUDIES OF ELECTRON AND HOLE TRAPPING LEVELS IN QUARTZ

Morde Chay Schlesinger 8 Oct. 1965 23 p refs Submitted for Publication

(Grant NsG-416)

(NASA-CR-68091; SRCC-13) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Illumination with monochromatic light into various color-center absorption bands of quartz at liquid nitrogen temperature (LNT) after previous X-ray irradiation at room temperature (RT) re-excites some glow peaks of the "usual" glow-curve in the region between LNT and RT. Re-excitation can also be performed for peaks above the temperature at which the crystal was x-irradiated. The effect has been investigated in detail for crystals doped with various impurities and under various conditions. The results are in agreement with the generally accepted models for the electronic processes in Quartz. Author

N66-12341 Research Triangle Inst., Durham, N. C. Solid State Labs.

SILICON INTEGRATED DEVICE THEORY

R. M. Burger and J. R. Hauser *In its* Design Parameters and Procedures for Functional Electron. Struct. Sep. 1965 p 207–218 refs Presented at the 4th Ann. Microelectron. Symp., St. Louis, May 1965 (See N66-12334 03-09)

A method of active function synthesis for silicon multijunction structures is described as an approach to the theory of silicon integrated devices. One step in the development of synthesis techniques is the solution of the partial differential equations for simple junction structures. Examples are given of such solutions, and methods for combining them for silicon multi-junction structures are described. Author

N66-12360 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATING RECOMBINATIONS ON NICKEL ATOMS IN p-GERMANIUM AT HIGH INJECTION LEVELS

A. P. Klimenko and Yu. O. Tkhorik *In its* Ukr. J. of Phys. 15 Jun. 1965 p 1–20 refs (See N66-12359 03-01)

The dependence of the life span of current carriers upon the injection level and temperature for p-germanium alloyed with nickel was investigated. The investigations were made on ten germanium samples. The temperature dependence of the specific base, Hall coefficient, and life span prior and after the introduction of nickel were determined. The temperature dependence was found to be typical for low-ohmic p-germanium with an admixture of nickel. Also, results were compared with the theory of recombination on repeated centers. It was shown that the temperature dependence in diodes is less pronounced than in massive samples, explained by the influence of surface recombination on efficiency which increases with cooling. E.E.B.

N66-12370 Joint Publications Research Service, Washington, D. C.

TECHNICAL ADVANCEMENTS IN THE GROWTH OF METAL AND SEMI-CONDUCTOR SINGLE CRYSTALS FROM THE MELT

Wei-Yuan Wang and Yuan-Sen Hsu *In its* Transl. on Communist China's Sci. and Technol., No. 234 8 Nov. 1965 p 38–56 refs (See N66-12367 03-34) CFSTI: $3.00

Progress is reported in the techniques of growing metal and semiconductor single crystals from the melt, including growth methods and defects, and external shape control. It was found that metal and semiconductor single crystals grown from melt have many excellent features: (1) rapid growth rates; (2) large crystals; (3) few defects; and (4) easily controlled shapes. However, it is pointed out that the decision must be made to use one of the four described methods with a given material on the basis of that material's properties (melting point, vapor pressure, chemical activity) and what is demanded of the single crystals (defects and external shape). Regarding germanium and silicon, raising the raw material purity, the reduction of high temperature melt contamination, and the continued advancement of single crystal growth techniques have made it possible for the growth of germanium and silicon single crystals to be industrialized. R.R.D.

N66-12396# General Electric Co., Schenectady, N. Y. Research and Development Center.

NEW SOLID-STATE DEVICE CONCEPTS Scientific Report No. 2

M. Aven, R. O. Carlson, R. S. Ehle, R. N. Hall, and H. H. Woodbury Jul. 1965 31 p ref

(Contract AF 19(628)-4976)

(AFCRL-65-611; AD-62194)

Attention on CdS was shifted to stoichiometric problems and the effects of O_2. Because of the high stability of SO_2, firing CdS in O_2 produces a 'reducing' action on the bulk crystal, equivalent to a small excess Cd firing. Electrical transport and contact properties of 1 to 10 ohm-cm n-type ZnS crystals were studied. Two types of levels were found below the conduction band of ZnS: shallow donor levels at 0.014 ev and deeper levels between 0.10 and 0.29 ev. Injection electroluminescent p-n junctions have been prepared from $ZnSe_{0.36}Te_{0.64}$ which show external quantum efficiencies of 18% at 70K. The resistance of various alloyed contacts and gold thermocompression bonds to n- and p-type GaAs was measured. The interface resistance of evaporated films of Ag, Au, and Al applied to GaAs is high unless the films are subjected to a high-temperature alloying step which damages their reflecting properties. Excellent laser diodes were made in which the p-type side was chemically etched down to within 2 microns of the junction. Author (TAB)

N66-12468# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON INTERVALLEY SCATTERING IN PbTe, Mg_2Ge, Ag, CdSb, ZnSb, TiO_2 CRYSTALS

D. M. Bercha and M. V. Tarnavskaia [1964] 6 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 6, 1964 p 642–646

Using group theory, the symmetry of small vibrations is determined in crystals which have O_h^5 or D_{2h}^{15} symmetry groups. The process of intervalley scattering in these crystals is examined. Author

N66-12492 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE DEPENDENCE OF THE MAGNETIC-FIELD INDUCED ANISOTROPY IN NICKEL–IRON FERRITES ON THE NICKEL CONCENTRATION

K. Motzke *In its* Monthly Reports of the Acad. of Sci. in Berlin 11 Jun. 1965 p 8 (See N66-12490 03-23)

The magnetic field temperature in Ni–Fe ferrites was investigated in both the 0° to +100° C and the +200° to +350° C temperature ranges as a function of Ni concentration. The results in connection with earlier studies on the dependence of the vacancy content were close to the supposition that the induced anisotropy at 0° to +100° C is essentially due to a rearrangement of Ni–Ni pairs. Anisotropy probably causes the simultaneous rearrangement of Fe–Fe pairs in both cases. The fact that both of these effects occur at different temperature ranges can be understood when the change in position Ni → vacancy requires a greater activation energy than the position change in Fe →vacancy. R.N.A.

N66-12518# Texas Instruments, Inc., Dallas. Central Research Labs.

SOLID-STATE TECHNIQUES FOR MODULATION AND DEMODULATION OF OPTICAL WAVES Seventh Quarterly Progress Report, 1 Jan.–31 Mar. 1965

William R. Clendinning and Dayton D. Eden 21 Jun. 1965 33 p refs

(Contract DA-36-039-AMC-03250(E))

(U7-802400-7; AD-621922)

Modulation: Preliminary tests were conducted with KTN (Potassium tantalate niobate). The observed clearing of the optical effects of crystal strains with applied bias fields is consistent with the results of an analytical development of the effect of strains in cubic crystals. Several in-cavity modulation techniques were studied, including the 45° Z-cut KDP configuration and also quartz in a standing-wave diffraction grating structure. Low-temperature measurements on deuterated KDP (Potassium dihydrogen phosphate) were in progress as the contract period ended. Modulator-demodulator systems: An attempt was made to transmit carrier band modulated laser light through the 1-km light pipe at Ft. Monmouth. The received light signal was of sufficient quality and intensity for good demodulator performance, but overall picture quality was poor. Failure was attributed to poor performance of standard components, in particular a poor signal level available from the rooftop antenna and excessive noise from the broadband TV booster amplifier. Author (TAB)

N66-12538# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics.

MAGNETIC-FIELD DEPENDENCE OF THERMAL CONDUCTIVITY MEASURED BY A CORBINO-DISK METHOD

Robert G. Morris, David L. Burdick, and R. Daniel Redin 20 Oct. 1965 18 p refs Presented at the 5th Thermal Conductivity Conf., Denver, 20–22 Oct. 1965

(Contract Nonr-2964(01))

(TR-15; AD-621705)

When heat flow due to charged carriers is radial in a thin cylindrical sample, a magnetic field applied parallel to the cylinder axis has maximum effect in reducing the thermal conductivity K because this Corbino-disk geometry prevents formation of a transverse temperature gradient. When a magnetic field is applied the method measures directly isothermal K; longitudinal-flow methods are likely to give approximately the adiabatic K. Measurements were made in the range 70-250C on n-InSb with fields 1000–8000 gauss. Maximum total change in K was −4%, somewhat smaller in magnitude than expected. The discrepancy may be due to lower electron mobility and to the difference in the directions of heat flow and sample growth. Author (TAB)

N66-12539# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics.

A SYSTEM FOR LOW-TEMPERATURE MEASUREMENTS OF THERMAL CONDUCTIVITY. MEASUREMENTS ON SILICON FROM 77° TO 300°K

Ronald J. Holyer (M.S. Thesis) 1 Oct. 1965 44 p refs

(Contract Nonr-2964(01))

(TR-14; AD-621152)

A sytem has been designed and constructed to measure thermal conductivity by the series comparative method in the temperature range 4 to 300K. A sample temperature of 77K was reached when the cylindrical sample chamber 3-1/4 inches in diameter and 8-3/4 inches long was evacuated to a pressure of 0.000003 Torr and submerged in a bath of liquid nitrogen held in a 5-1/2 liter stainless-steel dewar. Temperatures as low as 4.2K could be obtained if the sample chamber were submerged in liquid helium. Temperatures between that of the liquid bath and room temperature were obtained by electrical heating. A simple Wheat-stone bridge circuit, one arm of which was copper resistance thermometer made from 140 ohms of B and S No. 36 copper wire, served to regulate automatically the electrical heating so as to give a drift in sample temperature of less than 0.002 deg/min. Measurements were attempted from 77K to 300K on a sample of n-type single-crystal silicon with an impurity concentration of 5×10^{15} cu cm. Armco iron was used as a standard. Temperatures were measured with copper vs constantan thermocouples. The thermal conductivity of the sample was found to range from 8.7 watt/cm-degK at 98K to 1.8 watt/cm-degK at 255K. These values agree with those of Carruthers et al within 7% and of Glassbrenner and Slack within 10%. Author (TAB)

N66-12555# Kansas Univ., Lawrence.

AN INVESTIGATION OF SURFACE STATES ON SILICON EMPLOYING THE MOS CAPACITANCE METHOD

Donald W. Roberds (M.S. Thesis) Jun. 1965 99 p refs

(Contract AF 33(608)-1076)

(AD-620450)

The MOS (metal-oxide-semiconductor) device was used to measure the density and position within the forbidden gap of surface states on silicon. The theory of the silicon space charge is discussed and an equation for this charge is derived, relating it to the voltage drop across the silicon. The MOS structure, fabrication, and variation of capacity with d.c. bias voltage are discussed. Experimental results are presented of the determination of surface state density versus position in the band gap. TAB

N66-12616# Lincoln Lab., Mass. Inst. of Tech., Lexington.

BOTTOM OF THE SPIN-WAVE SPECTRUM IN A MAGNETIC FILM

Kenneth J. Harte 28 Jul. 1965 17 p refs *Its* TN-1965-31
(Contract AF 19(628)-5167)
(ESD-TDR-65-313; AD-619985)

The bottom of the spin-wave spectrum is examined for the case of a thin film magnetized in its plane. The bias field H_b and wave number k_b for the onset of first-order spin-wave instability at high microwave power is calculated. In addition, the critical thickness d_c, at which the uniform mode saturation process changes from first to second order, is obtained. These results are in fairly good agreement with experiment. Author (TAB)

N66-12624# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTICAL QUANTUM CRYSTAL GENERATOR WITH EXCITATION BY FAST ELECTRONS
N. G. Basov, O. V. Bogdankevich, and A. G. Devyatkov 15 Jun. 1965 8 p refs Transl. into ENGLISH from Tr. Fiz. Inst. Akad. Nauk SSSR (Moscow) 1964 7 p
(FTD-TT-65-555/1+2+4; AD-620973)

An optical quantum generator (LASER) was obtained pumping a cadmium sulfide single crystal with an electron beam, and its spectrum was studied. TAB

N66-12649 Library of Congress, Washington, D. C. Aerospace Technology Div.
THE SEARCH FOR HIGH-TEMPERATURE SEMICONDUCTOR MATERIAL (USSR)
John G. Kourilo *In its* Foreign Sci. Bull., Vol. 1, No. 11 Nov. 1965 p 33–37 refs (See N66-12644 03-34)

Recent Soviet experimental data on the silicides of rare earth metals are viewed as part of a systematic continuing study of binary rare earth compounds. The methods of preparing higher-purity silicides of Sc, Y, La, and Ce were perfected. A new pure compound, ScSi, was prepared and identified as a CrB-type structure. The Cr_5B_3-type crystal structure was attributed to La_5Si_3, Ce_5Si_3, Pr_5Si_3, and Nd_5Si_3 compounds in a study of Ce_5Si_3 single crystal. Earlier attributed crystal structures were confirmed for the compounds: La_3Si_2, Ce_3Si_2, Pr_3Si_2, Nd_5Si_3 (certain samples), Sm_5Si_3, and all M_5Si_3 compounds of the yttria-group, including Sc_5Si_3. Author

N66-12784# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
KINETICS OF IRREVERSIBLE PROCESSES OF REVERSE MAGNETIZATION OF FERRITES WITH RECTANGULAR HYSTERESIS LOOP
N. N. Sirota 19 Aug. 1962 11 p refs Transl. into ENGLISH from the book "Ferrity i Beskontaktnyye Elementy" Minsk, Izo-Vo AN BSSR, 1963 p 5–10
(FTD-TT-65-622/1+2+4; AD-620859)

The remagnetization process in time of ferrites with rectangular hysteresis loop is examined on the basis of a detailed analysis of the microscopic mechanism of domain wall displacement, return of magnetization vectors, mechanism of origination of remagnetization centers, as well as on macroscopic statistical examination of the process of origination and growth of remagnetization centers with consideration of the measurability of domain growth. TAB

N66-12785# HP Associates, Palo Alto, Calif.
SEMICONDUCTOR MATERIALS Interim Engineering Report, Apr. 15–Jul. 15, 1965
[1965] 41 p refs
(Contract NObsr-89489)
(IER-5; AD-620267)

The purpose and an outline of the planning of the renewed program for developing a display based upon a matrix array of GaAs (1-x)Px injection electroluminescent pn junction diodes is presented. A general analysis of the function of displays leads to an estimate of man's biological limit on processing visual sensory input information. A brief survey of current technology shows that the most promising future technology is a combination of modern integrated circuits with efficient light sources. The most likely candidate for such a combination are injection electroluminescent diodes, which represent the light source most compatible with integrated circuits. An analysis of the cross-grid problem for the case of the light-voltage and lightcurrent characteristics of a el diodes indicates that an ideal el diode with a vanishingly small bulk (series) resistance would not be subject to the cross-grid limitations of resistive and capacitive el elements and would provide satisfactory picture contrast when driven in a dot sequential scanning mode for panels containing 100,000–1,000,000 picture elements. Author (TAB)

N66-12853*# Field Emission Corp., McMinnville, Oreg.
INVESTIGATION OF ELECTRON EMISSION CHARACTERISTICS OF LOW WORK FUNCTION SURFACES Quarterly Progress Report No. 3, 1 Apr.–30 Jun. 1965
L. W. Swanson and L. C. Crouser 25 Aug. 1965 44 p refs
(Contract NASw-1082)
(NASA-CR-68187) CFSTI: HC $2.00/MF $0.50 CSCL 20L

An investigation of the total energy distribution of field emitted electrons has been performed in the temperature range 77–900° K for five different crystallographic directions of a tungsten field emitter. The results obtained generally confirmed the contemporary field emission theory throughout the range of temperatures investigated. A theoretical discussion of the total energy distribution of field emitted electrons reveals that band structure effects, due to discrepancies from the free electron model generally assumed by contemporary field emission theory, are observed only in crystallographic directions exhibiting a Fermi surface of high radius of curvature. A review of existing solid state measurements of the band structure of tungsten indicates the possibility of significant anisotropies in the Fermi surface along the (100) direction. These expectations are reinforced by the anomalous shoulder on the total energy distributions about .35 ev below the Fermi level along the (100) directions. Fowler–Nordheim plots as a function of temperature on several major planes of a tungsten emitter were analyzed to give the temperature dependence of the local work function. Author

N66-12904# Dominion Physical Lab., Lower Hutts (New Zealand). Dept. of Scientific and Industrial Research.
THE PHOTOCONDUCTIVITY OF CHLOROPHYLL MONOLAYERS
K. J. Mc Cree and R. L. Jones 15 Jan. 1963 12 p refs
(R-300) CFSTI: HC $1.00/MF $0.50

Pure chlorophyll has been laid down as a stack of monomolecular layers on a photoconductivity grid. With gold electrodes, the photocurrent responded instantly to the light, whereas with aluminium, silver and colloidal graphite it did not. The photocurrent was very small, and not significantly greater than with a chlorophyll film which had been deposited by evaporation from an organic solvent. One electron per second was collected for every 10^8 quanta per second absorbed. Author

N66-12990*# Columbia Univ., New York.
FIELD ION MICROSCOPE INVESTIGATIONS OF SOLID SOLUTIONS Annual Report
Eugene S. Machlin 1 Jul. 1965 36 p refs
(Grant NsG-294)
(NASA-CR-68367) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Field ion microscopic studies of solid solutions centered on solute atoms and their occupation of interstitial lattice sites as well as of substitutional lattice sites. A diffusion method was established to inject C and N solute atoms into the tungsten lattice. Newly developed pulse evaporation techniques were used for imaging the O interstitial in tungsten, and to measure the lattice solid solubilities of carbon, nitrogen, and oxygen in tungsten. Low temperature electron microscope studies of 2% W in Pt alloy established the lattice positions of solute atoms in the alloy. Motion pictures recorded the continuous evaporation of (102) planes, in which the individual atoms were imaged. G.G.

N66-13069# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
SCATTERING OF LONG WAVELENGTH PHONONS BY POINT IMPERFECTIONS IN CRYSTALS
J. A. Krumhansl and J. A. D. Matthew Jun. 1965 29 p refs
(Contract AT(30-1)-2391)
(NYO-2391-11)

At very low temperatures the thermal conductivity of insulating crystals containing point defects is limited by boundary relaxation processes and by Rayleigh scattering of long wavelength phonons; at higher temperatures resonant modifications of Rayleigh scattering and phonon-phonon scattering dominate. Experiments on the thermal conductivity of alkali halide crystals containing monovalent impurities indicate that the inverse relaxation time computed from experiment for Rayleigh scattering is in some situations very much less than that calculated on the assumption that the defects are isotopic impurities. Since the scattering of phonons in a one dimensional chain may be discussed without approximation, the problem was solved and results show that mass and spring changes round the imperfection may give compensating contributions to the scattering amplitude; the scattering power of the center may thereby be reduced to below the value calculated on the basis of pure isotope scattering. A generalization of these ideas not dependent on Born approximation is presented using formal scattering theory adapted to handle this case.
Author (NSA)

N66-13174*# Old Dominion Coll., Norfolk, Va. Dept. of Physics.
DEFECT ANNEALING IN IRRADIATED SEMICONDUCTORS Progress Report, Apr. 1–Sep. 30, 1965
W. Maurice Pritchard 1 Oct. 1965 13 p refs
(Grant NsG-602)
(NASA-CR-68458) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The possibility of obtaining exact analytic solutions of the general annealing equations with one secondary defect complex was further investigated. It was found that the problem of finding exact analytic solutions is equivalent to the problem of solving the Abelian equation, for which no standard technique exists. Development of approximate solutions of the annealing equations with one secondary defect complex was also undertaken, with a partially linearized version of the primary equation considered. In order to obtain the fraction of defects not annealed, it was necessary to integrate the equation used to find the annealing plateau level for a particular set of model parameters. A computer program was written to perform the integration. M.G.J.

N66-13203# Franklin Inst., Philadelphia, Pa. Research Labs.
A STUDY OF CARRIER INJECTION AND CONDUCTIVITY IN ORGANIC SOLIDS Final Report, 1 Aug. 1962–31 Jul. 1965
P. J. Reucroft, O. N. Rudyj, and M. M. Labes 31 Jul. 1965 100 p refs
(Contract AF 19(628)-1660)
(AFCRL-65-616; F-1990; AD-473773)

Bulk dark and photoconductivity studies on a range of electron acceptor crystals in the presence of electron donor vapors and vice versa have demonstrated the role of charge-transfer interaction at the crystal surface in producing charge carrier injection in organic crystals. The electron acceptor crystal, p-chloranil, exposed to donor vapors such as ammonia and aliphatic amines, and anthracene, an electron donor crystal, exposed to the acceptor vapor iodine, have received the most attention. In these systems it is concluded that the ambient vapor induced carrier injection process takes place most probably at the electrode crystal interface. Space-charge-limited currents are not produced, however, until high field strengths when charge carrier injection leading to space-charge-limited conditions takes place in the absence of ambient vapor and tends to obscure ambient effects. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-12486# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).
INVESTIGATIONS ON THE OXY-COMPOUNDS OF FLUORINE AND THEIR APPLICABILITY IN ROCKET PROPULSION [UBER DIE SAUERSTOFFFLUORIDE UND IHRE VERWENDUNGSMOGLICHKEITEN IN DER RAKETENTECHNIK]
D. Genthe Feb. 1965 31 p refs In GERMAN; ENGLISH and FRENCH summaries
(DLR-FB-65-29) CFSTI: HC $2.00/MF $0.50

A review on oxy-compounds of fluorine and recent results is given. After describing the most important methods of synthesis, physico-chemical dates and properties, applicabilities in rocket propulsion systems are discussed. Author

N66-12831# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ADDITIVE FOR SUPPRESSING VANADIUM CORROSION OF FUELS
R. A. Lipshteyn, A. S. Avetisyan et al 20 Sep. 1965 6 p Transl. into ENGLISH from Soviet Patent no. 162269 (Appl. no. 849707/23-4, 29 Jul. 1963 1 p
(FTD-TT-65-505/1+4; AD-621778)

The object of the invention is an additive for suppressing vanadium corrosion of fuels on the basis of green oil. For the purpose of improving the additive's properties tetraethoxysilane or the bottoms in the production of tetraethoxysilane is added to the green oil. Author (TAB)

N66-12871*# Battelle Memorial Inst., Columbus, Ohio.
A STUDY OF SOLID-PROPELLANT VAPORIZATION AND DIFFUSION PROCESSES Final Technical Report
J. W. Droege, R. W. King, J. S. Mc Nulty, and A. Levy 31 Aug. 1965 32 p refs
(Contracts NAS7-100; JPL-950813)
(NASA-CR-68228) CFSTI: HC $2.00/MF $0.50 CSCL 21I

The vaporization and diffusion processes for dioctyl adipate and ferrocene in a polyurethane propellant were studied in some detail; phenyl-beta-naphthylamine was studied in less detail. Vapor pressures of these three additives were measured. Diffusion studies were carried out on propellant samples containing dioctyl adipate and ferrocene. Measurements were made between 30 and 70° C. The diffusion coefficients found for these two materials were nearly the same. The vapor pressures differed by several orders of magnitude. Diffusion appeared to take place predominantly through the polymer phase. There were some indications of structure-dependent diffusion through cracks and boundaries between the binder and the oxidizer. If one assumes a rocket configuration in which the effective throat area is about 3×10^{-3} times the area of exposed propellant surface, then one concludes that at about 30° C the loss of dioctyl adipate will be controlled by its rate of effusion from the nozzle. Over a period of a few years, the loss would be negligible. For ferrocene, with a much higher vapor pressure, the loss is diffusion controlled and in a year would deplete the propellant considerably within a few millimeters of the surface, leaving the bulk of the propellant unaffected. Author

N66-13167*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
CATALYSIS OF HYDROGEN-ATOM RECOMBINATION IN ROCKET NOZZLES
J. A. Lordi and R. E. Mates Jul. 1965 49 p refs
(Contract NASr-109)
(NASA-CR-68543; CAL-AD-1689-A-S) CFSTI: HC $2.00/MF $0.50 CSCL 21I

The use of gas-phase catalysis has previously been suggested as a means of enhancing hydrogen-atom recombination and hence the performance of nuclear or electrically powered rocket engines. In the present study the use of oxygen and an oxygen-nitrogen mixture as catalysts has been examined. The results of the calculations indicate that gas-phase catalysis leads to a marginal increase in specific impulse. The hydrogen-atom recombination was significantly enhanced, but the accompanying increase in the molecular weight of the fluid led to slight losses or gains in specific impulse depending on the reaction-rate constants employed for the catalytic mechanisms. The results are used to establish the minimum requirements which an additive must satisfy to yield a gain in specific impulse. An expression is derived for a "catalytic parameter" which gives an approximation for the gain in performance which can be expected for a given additive. Also, the results show that a significant saving in tankage weight may be possible despite only marginal gains in specific impulse. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-12158*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMBINED HIGH-LOW THRUST PROPULSION FOR THE CLOSE SOLAR PROBE MISSION
William C. Strack Washington, NASA, Dec. 1965 35 p refs
(NASA-TN-D-3145) CFSTI: HC $2.00/MF $0.50 CSCL 21H

Several types of propulsion systems are evaluated for the 0.1-AU solar probe mission commencing from a low, circular Earth orbit. The four propulsion systems compared are the chemical rocket, the nuclear rocket, the electric rocket, and the chemical-electric hybrid system. The chemical-electric hybrid system consists of a chemical first stage fired until at least escape velocity is attained and an electrically propelled second stage. For this comparison, calculus of variations calculations were performed upon a mathematical model set up for electric and chemical-electric hybrid systems employing constant-thrust engines. It is shown that the chemical-electric hybrid is by far the most attractive system for present and near future powerplant technology. In particular, the Saturn IB booster cannot deliver any payload to 0.1 AU if existing (or near future) hardware is utilized regardless of the upper stage propulsion choice except for the chemical-electric hybrid system. The study considers mission times between 60 and 650 days and specific electric powerplant masses from 10 to 150 pounds per kilowatt. Author

N66-12165* National Aeronautics and Space Administration. Washington, D. C.
A CONCEPT FOR AN AERONAUTICAL MACHINE
N. I. Kibal'chich *In its* Pioneers of Rocket Technol. Nov. 1965 p 9–14 (See N66-12164 03-30) CFSTI: HC $5.00/MF $1.00

This article written in 1881 proposes a concept for a space rocket which would use pressured gunpowder as the propellant. Flight stability, orientation, and reentry are mentioned. E.E.B.

N66-12349*# Hughes Research Labs., Malibu, Calif.
ION ENGINE SUPPORTING RESEARCH AND EVALUATION. VOLUME II: IONIZATION STUDIES Summary Report
O. K. Husmann Nov. 1965 106 p refs
(Contract NAS3-4110)
(NASA-CR-54411) CFSTI: HC $4.00/MF $0.75 CSCL 21C

Porous tungsten pellets were improved by using highly classified spherical tungsten powder. Neutral efflux as low as 2.7% at 10 mA/cm^2 has been measured, with critical temperature only about 20° K above that of the solid metal. Hydrocarbons efficiently carburize the ionizer; therefore their partial pressure should be below 10^{-10} Torr for the 1000 hour test. With carburization, the critical temperature increases; and in the case of W_2C and WC the neutral efflux increases due to the lowered work function. In the case of pyrolytic graphite deposits, the work function slightly exceeds that of tungsten. Cesium ion desorption energies, measured by the pulsed desorption technique, are in reasonable agreement with the theoretical interpretation, if the quantum-corrected image force and the ion polarizability are considered. These measurements are in good agreement with desorption energies computed from critical temperature data, if changes in surface coverage are considered. Author

N66-12382# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR CUTOFF OF FUEL SUPPLY TO A LIQUID-PROPELLANT ROCKET ENGINE
L. A. Arinushkin, A. Yu. Polinovskiy, and I. M. Nosotsov 23 Jul. 1965 5 p Transl. into ENGLISH from Soviet Patent no. 165620 (Appl. no. 783381/24-6, 30 Jun. 1962) 2 p
(FTD-TT-65-470/1+2+4; AD-619489)

A device for cutting off the supply of fuel to a liquidpropellant rocket engine is described. The valve consists of a body (housing) inside of which there are conical seats and there is placed a valve controllable by a pyromechanism. The plate and stock are provided with conical sealing bands. The sealing bands have the distinguishing feature of creating a more dependable hermetic sealing through the assuring of independent wedging of the sealing bands. The stock of the valve is designed from two parts mutually movable in the axial direction, joined to each other by a sleeve. Author (TAB)

N66-12479# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).
METHODS OF CALCULATION FOR THE DETERMINATION OF MIXTURE RATIO DISTRIBUTION IN A COMBUSTION CHAMBER TAKING INTO ACCOUNT VAPORIZATION AND COMBUSTION [BERECHNUNGSVERFAHREN ZUR ERMITTLUNG DER MISCHUNGSVERHALTNISVERTEILUNG IN EINER RAKETENBRENNKAMMER UNTER BERUCKSICHTIGUNG VON VERDAMPFUNG UND VERBRENNUNG]
H. Twardy May 1965 44 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-32) CFSTI: HC $2.00/MF $0.50

From cold water spray tests with injection nozzles for rocket combustion chambers it is known that—when observing single points in the cross section of a combustion chamber—there is no constant mixture ratio distribution of fuel and oxidizer. This leads to the assumption that the local mixture ratio distribution of vaporizing and reacting masses of fuel and oxidizer is also quite different. Therefore, the local combustion temperature within the chamber is expected to be different. The calculations described here are applicable for determinating the local mixture ratio distribution of vaporized fuel and oxidizer, if the specific droplet parameters are known from cold spray tests as droplet diameter, number of droplets per second and droplet position within the spray zone. The way of droplets in the gas stream through the chamber may be calculated step by step and the local masses vaporized from droplets when moving through the chamber. The heating up period of droplets and ignition delay are considered. Author

N66-12508# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FAST ACTING VALVE FOR FEEDING LIQUID, E. G., FUEL COMPONENTS IN LIQUID ROCKET ENGINES
Yu. V. Belyayev, A. D. Denisova et al 24 Aug. 1965 5 p Transl. into ENGLISH from Soviet patent no. 164512 (Appl. no. 864737/24-6, 10 Nov. 1963) 1 p
(FTD-TT-65-473/1+2+4; AD-620791)

A fast acting valve for feeding liquid, for example, fuel components in liquid rocket engines, having a body, membrane, overlapping passing section and membrane piercing organ with pyro drive is described. The pyro drive is not connected in power scheme with the body and is separated from the flow through section by a flexible diaphragm, controlling the piercing organ and isolating the body from high pressure gases. Author (TAB)

N66-12606# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESOURCE INCREASED IN DOUBLE
M. Gal'perin, G. Ushakov, and G. Vasil'chenko 26 Aug. 1965 10 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 8, 1964 p 28–29
(FTD-TT-65-723/1+2+4; AD-620974)

The general service life and time before first repair of piston type aircraft engines was almost doubled by improving the air flow of the cylinder, reducing cylinder temperature, improving lubrication and reducing load on pistons of main connecting rods. TAB

N66-12834# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INVESTIGATION OF THE EFFECT OF PLUG TRANSLATION ON THE THRUST VECTOR OF A MACH 3 PLUG NOZZLE
Richard K. Ellingson (M.S. Thesis) Jun. 1965 47 p refs
(GAM/65B/ME/65-3; AD-621028)

An experimental investigation was made of a convergent plug exhaust nozzle to determine if effective thrust vectoring could be achieved through the use of a translating plug which travels in plane motion across a base region of slightly increased diameter. The objective was to determine if effective thrust vectoring could be obtained at higher pressure ratios than 6.2 Results showed that when operating at pressure ratios below the design value the amount and direction of thrust vectoring obtained was a strong function of the pressure ratio. For underexpanded operation the thrust vectoring was found to be nearly independent of the pressure ratio, but of too small a magnitude to be significant. The axial thrust was materially reduced by the step in both plugs. TAB

N66-12874*# Marquardt Corp., Van Nuys, Calif.
REFRACTORY THRUST CHAMBERS FOR SPACECRAFT ENGINES Final Report
J. G. Campbell and C. D. Coulbert 22 Mar. 1965 156 p *Its* Rept. No. 6086
(Contract NAS7-262)
(NASA-CR-68183) CFSTI: HC $5.00/MF $1.00 CSCL 21H

Pyrolytic graphite and alloys of pyrolytic graphite containing hafnium and zirconium have been investigated experimentally for application to liquid propellant rocket thrust chambers and nozzles. A study of the maximum structural capability of free standing pyrolytic graphite was conducted using 2-inch diameter thin walled tubes. The effects on tube rupture pressure of heat treatment, microstructure, crystal lattice spacing, surface finish, and maximum nodule size were evaluated. A definite correlation between maximum nodule size and rupture strength was found. In motor test firings with gaseous O_2/H_2 propellants, much less erosion was observed with an edge oriented nozzle made with washer shaped sections of pyrolytic graphite–zirconium alloy than with an unalloyed pyrolytic graphite nozzle. The oxidation protection of the zirconium alloy was due to formation of a surface coating of ZrO_2 in the oxidizing environment. A motor test firing with a free standing hafnium alloy thrust chamber indicated that the oxidation protection afforded by the alloys is probably more effective in the edge oriented designs than in the free standing chamber designs. Author

N66-13000*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
SOLAR-POWERED ELECTRIC PROPULSION SPACECRAFT Bi-Monthly Report No. 3, Jul.–Aug. 1965
Robert H. Stivers Sep. 1965 149 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951144)
(NASA-CR-68374) CFSTI: HC $4.00/MF $1.00 CSCL 21C

Physical work on the development of a solar powered electric propulsion spacecraft during July and August, 1965 centered on studies of the propulsion system and hardware, spacecrafts system design, and extension of the low thrust mission

analysis to include fly-by heliocentric transfer trajectory from 1971 to 1975. The effect of power level on the design and operating characteristics of the Hg pool cathode electron-bombardment ion engine and its feed system was investigated; a conceptual design of a modularized pool cathode engine system was devised; a preliminary analysis of the thermal, mechanical, and electrical integration problems associated with the ion engine was performed; and the thrust vector displacement in redundant thrustor arrays was investigated. Present system design efforts involved the extension of the spacecraft bus to a 100 inch square cross section in lieu of the 100 inch cylindrical envelope. A proposed general arrangement for the Saturn IB/Centaur Solar Electric Propulsion spacecraft is presented. G.G.

N66-13047*# Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.

SCOUT MOTOR PERFORMANCE ANALYSIS AND PREDICTION STUDY (PAPS)

C. K. Whitney, T. F. Owens (Thiokol Chem. Corp.), J. Paskind (Aerojet-Gen. Corp.), and M. B. Rubin (Hercules Powder Co.) Washington, NASA, Dec. 1965 193 p refs Prepared jointly by Thiokol Chem. Corp., Aerojet-Gen. Corp., and Hercules Powder Co.

(Contracts NAS1-3683; NAS1-3684; NAS1-3685; NAS1-3686) (NASA-CR-336) CFSTI: HC $5.00/MF $1.25 CSCL 21H

The Scout motor performance analysis and prediction study was initiated by gathering available data needed to establish motor performance prediction and evaluation procedures. An improvement in predicting and evaluating motor burn times and thrust levels was made by changing the concept of web burn time. Changes in the procedure for reducing this value eliminate error resulting from subjective interpretation of an analog trace. More accurate correlations of motor burn rate with propellant test burn rate were developed. Nominal curves of Scout motor thrust and chamber pressure versus burning time were derived from sea level ambient test data and vacuum tunnel test data. Nominal propellant specific impulse values were based on available test data with confirmation by data from ground tests with ambient pressure conditions. Curves of motor inerts consumption versus time were developed. A rational equation was derived for calculating propellant flow rate according to the inerts flow rate and other motor operating conditions that change during burning time. Flight motor performance was compared with ground test performance, considering burn rate, shape of thrust and pressure time histories, and total integrals of pressure and thrust. The repredicted motor data showed an improvement over the originally predicted motor data. R.N.A.

N66-13242*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

ARCJET TECHNOLOGY RESEARCH AND DEVELOPMENT Final Report, 3 Jun. 1964–11 Sep. 1965

22 Dec. 1965 187 p refs

(Contract NAS3-5900)

(NASA-CR-54687; RAD-TR-65-37) CFSTI: HC $5.00/MF $1.25 CSCL 21C

Experimental results are presented on the propulsion performance of an MPD arcjet thrustor operated on both gaseous and alkali metal vapor propellants. The overall electric to thrust power efficiency appears to be primarily a function of the specific impulse and propellant type, and is quite insensitive to the absolute value of either the input power or the applied external magnetic field. The propulsion data obtained for engine operation with gaseous propellants at low mass flows is open to question because of the existence of gas entrainment; operation of the MPD arcjet thrustor with the condensable alkali metal vapor propellants, and thus reduced test tank back pressures, has reduced but not eliminated the possibility of interaction between the acceleration process and the test tank environment. Although the performance of the MPD arcjet (> 50% efficiency at 5000 seconds specific impulse) continues to look attractive, work is urgently required to determine the nature and extent of the gas acceleration process. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-12185*# Advanced Research Corp., Atlanta, Ga.

INVESTIGATION OF BREMSSTRAHLUNG PRODUCTION IN A SHIELDING MATERIAL

May 1965 16 p refs

(Contract NAS8-11083)

(NASA-CR-68107) CFSTI: HC $1.00/MF $0.50 CSCL 18F

Shielding effects of an infinite slab embedded in an isotropic electron source were studied. A model was derived from calculations on the electron source spectrum, the electron penetration, the Bremsstrahlung production, the photon penetration, and the flux-to-dose conversion. Considered were the following assumptions for the electron and photon penetrations: (1) straight-ahead, continuous slowing down of the penetrating electrons; (2) straight-ahead Bremsstrahlung production; and (3) a plane source of isotropic radiation at each depth x. Preliminary calculations were made for an aluminum slab having a thickness of 4 gm/cm^2 by performing a five-point Gaussian quadrature over the angle of photon momentum; followed by a nine-point trapezoidal integration over x. The relative importance of the electron contributions from various parts of the Bremsstrahlung production cross section were determined by summing the contributions from the regions of interest and subsequent comparison with the total dose rate. Results are given for the dose rate of Roentgens per hour. G.G.

N66-12247*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.

PION PRODUCTION IN HIGH ENERGY COSMIC RAY COLLISIONS

Martin S. Spergel, M. Lieber, and S. N. Milford Jun. 1965 43 p refs

(Contract NASw-699)

(NASA-CR-68092; RE-215J) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The Landau–Milekhin hydrodynamic model of very high energy nucleon interactions is extended to calculate the pion energy and angle distributions in the center of mass system (CMS) and laboratory frames. Consideration of the physical limitations on the average energy of the pions produced in the decomposition of the nucleonic fluids leads to truncation of the pion distribution and a rather slow energy dependence of the average CMS pion energy on the incident proton energy. When a power law dependence is chosen for incident primary cosmic ray protons, the pion production spectrum found in the laboratory frame has a steeper energy spectrum than those found using simpler models of nucleon interactions. Author

N66-12351* # Southwest Center for Advanced Studies, Dallas, Tex.
[TO DEVELOP AND EVALUATE TECHNIQUES AND INSTRUMENTATION FOR THE MEASUREMENT OF COSMIC RADIATION ANISOTROPIES] Quarterly Progress Report Combining Periods, 1 Apr.–30 Jun. and 1 Jul.–30 Sep. 1965
K. G. Mc Cracken [1965] 27 p refs
(Contracts NASr-198; AF 19(628)-5028)
(NASA-CR-67941) CFSTI: HC $1.00/MF $0.50 CSCL 20H

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1. THE SEMI-DIURNAL ANISOTROPY OF THE COSMIC RADIATION J. G. Ables, K. G. McCracken, and U. R. Rao 13 p refs (See N66-12352 03-29)

2. A CELESTIAL SOURCE OF X-RAYS IN THE ENERGY RANGE 20 TO 58 KEV K. G. McCracken 13 p refs (See N66-12353 03-29)

N66-12352* Southwest Center for Advanced Studies, Dallas, Tex.
THE SEMI-DIURNAL ANISOTROPY OF THE COSMIC RADIATION
J. G. Ables, K. G. Mc Cracken, and U. R. Rao *In its* [To Develop and Evaluate Techniques and Instrumentation for the Meas. of Cosmic Radiation Anisotropies] [1965] 13 p refs Presented at the 9th Intern. Conf. on Cosmic Rays, London, 6–17 Sep. 1965 (See N66-12351 02-29) CFSTI: HC $1.00/MF $0.50
(Contracts NASr-198; AF 19(628)-5028)

Using data from 14 different neutron monitors, the semidiurnal anisotropy of the cosmic radiation during the period 1953–1965 has been investigated. Numerical filter techniques, consisting of numerical heterodyne filtration followed by phase and amplitude demodulation (complex demodulation) has been employed. This process reduces to ordinary harmonic analysis as a special case. The effective filter response function for harmonic analysis is compared with the more desirable response functions employed in this investigation. Phase and amplitude distribution histograms for each station and year have been constructed which, when fully corrected for the effects of geomagnetic bending of primary trajectories, indicate a consistent semidiurnal anisotropy having an amplitude of approximately 0.1% and maxima along a line 60° west of the earth-sun line. A study of the energy dependence of this anisotropy has been made which, though not conclusive, indicates that the anisotropy may be energy dependent.
Author

N66-12353* Southwest Center for Advanced Studies, Dallas, Tex.
A CELESTIAL SOURCE OF X-RAYS IN THE ENERGY RANGE 20 TO 58 KeV
K. G. Mc Cracken *In its* [To Develop and Evaluate Techniques and Instrumentation for the Meas. of Cosmic Radiation Anisotropies] [1965] 13 p refs Presented at the 9th Intern. Conf. on Cosmic Rays, London, 6–17 Sep. 1965 (See N66-12351 03-29) CFSTI: HC $1.00/MF $0.50
(Contract NASr-198; Grant NsG-269-62)

An experiment designed to search for celestial sources of X-rays in the energy range 20–58 kev is described. A source of X-rays has been observed in the constellation Cygnus, and a tentative identification with Cygnus XR-1 is made. The X-ray, and radio data indicate that the spectrum of the Cyg XR-1 source is significantly different from that of the X-ray/radio emitter Taurus A.
Author

N66-12418* California Univ., San Diego.
EXPERIMENTS IN X-RAY AND GAMMA-RAY ASTRONOMY
Laurence E. Peterson *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 15 p refs (See N66-12401 03-34)
(Contracts NASw-56; NAS5-3122; NAS5-3077; Grant NsG-318)
GPO: HC $1.50; CFSTI: MF $2.00

A unified program in X-ray and gamma-ray astronomy, in which balloon experiments were used to support satellite missions, is described. The experiment for the Orbiting Solar Observatory (OSO) was designed to provide broad energy and angular resolution for nonsolar gamma rays, to monitor the sun for solar bursts, and to provide information on the general background, in the region of the spectrum from 50 keV to about 3 MeV. The balloon experiments were conducted to increase basic knowledge of cosmic ray processes in the atmosphere, and to test instrument designs for X-ray and gamma ray astronomy. The instrumental techniques used are described, and the data results are indicated. How this program fits into the academic program as a whole is discussed, along with the way in which an investigator uses staff, students and facilities in a NASA-supported program.
M.G.J.

N66-12470# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
SOLAR RADIO FLUX DURING THE IQSY AT UNIVERSITY PARK, PENNA., APRIL–MAY–JUNE, 1965
John P. Hagen 20 Dec. 1965 31 p
(Grant NSF GP-2986)
(SR-258D)

This report contains solar radio flux data recorded at 10700 mc/s and 2700 mc/s, during the quarter 1 April 1965 to 30 June 1965. A table of distinct events is also given.
Author

N66-12571# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
MEASUREMENT OF SOLAR RADIATION AT 430 MEGACYCLES Quarterly Status Report, Feb. 1–Jul. 31, 1965
M. H. Cohen Aug. 1965 6 p refs
(Contract Nonr-401(27))
(CRSR-203; AD-620250)

The preliminary study of the polarization of solar bursts at 430 MH_z was completed with observations of more than 200 hours. As the sun was very quiet, only six bursts were detected. Their characteristics are shown. The type III bursts were medium to strongly polarized, elliptically to linearly. This was in contrast to measurements made at lower frequencies, where the polarization was weak to medium, and generally circular.
R.W.H.

N66-12647 Library of Congress, Washington, D. C. Aerospace Technology Div.
ORIGIN OF THE EARTH'S RADIATION BELTS AND THE CORRELATION BETWEEN THE BELTS AND THE IONOSPHERE
Edward Gelins *In its* Foreign Sci. Bull., Vol. 1, No. 11 Nov. 1965 p 18–28 refs (See N66-12644 03-34)

Two papers are discussed which deal with the distribution of the geomagnetic force lines according to the allowed and forbidden Stormer areas and the formation of the phenomena creating the magnetosphere around the earth by the interaction between the stream of solar charged particles and the magnetic force lines. Three other papers are reviewed which

deal with the distribution of heterogeneities in the upper ionosphere. These heterogeneities and their variations are assumed to be caused by the plasma of solar charged particles which have penetrated into the magnetosphere. Author

N66-12750# International Geophysical Year World Data Center A, Washington, D. C. Coordination Office.
CATALOGUE OF DATA IN WORLD DATA CENTER A: AIRGLOW, IONOSPHERE, AURORA (INSTRUMENTAL), AURORA (VISUAL), COSMIC RAYS, GEOMAGNETISM, AND SOLAR ACTIVITY. DATA RECEIVED DURING THE PERIOD 1 JUL. 1957–30 JUN. 1965
Sep. 1965 120 p refs Sponsored by NSF

A catalog of international exchange data from geophysical observations is given. Included are aurora, cosmic ray, geomagnetism, airglow, ionosphere, and solar activity data. C.T.C.

N66-12770 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM OF CLASSIFIYING THE SPECTRA OF POLAR AURORAE
V. I. Ivanchuk and Ye. S. Kurochka *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 78–87 refs (See N66-12765 03-13)

Spectrometric observations made during the IGY point to great complexity and confusion in the behavior of various polar auroral emissions. In part, this is attributed to the low space-time resolution obtained, which to a certain measure is offset by the wide variety and volume of observations made. When more than 100 spectra for the region between 4700 and 6100Å were processed, it was possible to isolate as many as ten different groups, which fall within a certain continuous sequence. It is shown that the position of the spectrum in a given sequence is best characterized by the ratio of the intensities of two adjacent lines, and the spectral type may be based on a parameter such as the effective height of luminescence. Spectral type and average brightness are tabulated for 36 spectra, with forms and color of the auroras indicated; and the existence of a relationship between spectral type and polar auroral brightness is confirmed. M.W.R.

N66-12771 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE POSSIBILITIES OF ELEMENTARY MOLECULAR AND ATOMIC IONIZATION AND DISSOCIATION PROCESSES IN POLAR AURORAE OWING TO HYDROGEN AND HELIUM IONS FROM THE SUN
V. I. Cherednichenko *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 88–102 refs (See N66-12765 03-13)

Diagrams are constructed to show the most probable molecular conversions for nitrogen, oxygen, and water in the terrestrial atmosphere due to their interaction with hydrogen and helium ions from the sun. Maximum effective cross sections are computed from empirical formulas for the following processes in polar auroras: (1) molecular dissociation by ion impact with and without ionized products of decay and (2) molecular charge transfer with simultaneous molecular dissociation. Examination of interactions between solar corpuscles and molecules of the terrestrial atmosphere indicates charge transfer alone, with ionization, and with dissociation are the most likely processes in molecular conversions. And, while the He^+ and He^{++} ions occur less frequently than H^+ ions in corpuscular streams, all three kinds of ions may play an important role in molecular dissociation in polar auroras. M.W.R.

N66-12772 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CORPUSCULAR MECHANISMS FOR EXCITATION OF ULTRAVIOLET EMISSIONS IN POLAR AURORAE
V. I. Cherednichenko *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 103–119 refs (See N66-12765 03-13)

Consideration is given to the possibility of exciting ultraviolet polar auroral emissions through the action of solar corpuscular radiation on atoms and molecules of the terrestrial atmosphere. Theoretical computations for the effective cross section (ECS) agree with experimental values and correspond to the energy of the incident particles. The ECS of de-excitation of $N(^2P)$ atoms with ionization is found to be very small; whereas ECS's for extinction with charge transfer are rather substantial. Magnitude of proton concentration at the lower polar auroral boundary is calculated and the extension of luminosity from electron impact is considered. If a temperature of about 15 000° K is developed in polar auroras under conditions of gas discharge, then electron excitation will make a noticeable contribution to the excitation of 2PG N_2 bands. At temperatures as great as 100 000° K, electron impact cannot be responsible for the observed intensity of 1NG N_2^+. M.W.R.

N66-12773 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN FEATURES OF POLAR AURORAL FORMS WITH RAY STRUCTURE
N. I. Dzyubenko *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 120–128 refs (See N66-12765 03-13)

Twelve photographs taken in the U.S.S.R. were used to study the structure features of polar auroral rays. All of the aurora were of conventional green coloration, and most of them had brightness above three points. Height and azimuth were determined from stars which appeared on the photographs; slant ranges of border points from height above the horizon. Periodicity in brightness distribution along the arc with ray structure was noted for most of the auroras, and the absolute values of the spatial periods were determined. Tabulated results indicate a relative error as great as 25%. Width of the rays was determined by several microphotometric sections along the ray-structure arcs, with rays having the least amount of blurring selected. Widths given are only approximations because of the influence of motion. It is considered possible that the results obtained may be associated with horizontal electrical discharge in the upper atmosphere and may be analogous to the stratification which occurs in gas discharge tubes. M.W.R.

N66-12774 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS RELATING TO THE LOCAL GEOGRAPHIC DISTRIBUTION AND DYNAMICS OF POLAR AURORAE
Ye. A. Ponomarev and I. A. Rudenko *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 129–139 refs (See N66-12765 03-13)

Projections on a "transform" chart are used to see how luminosity of polar auroral arcs is positioned relative to the coastline. This type chart was prepared by plotting 117 points along the coastline and rivers of a map of the Tiksi Bay region, with no points farther than 900 km from the center. Azimuth and distance for each point relative to the selected center were determined by formulas from spherical trigonometry; for distances less than 150 km plane geometry calculations were made. By tracing the motion of various auroral forms, transition of one form to another and changes in brightness were

evaluated. Analyses of these results indicate that the properties of ground surfaces affect the development of polar auroras. The role of magnetic field in determining the direction of polar auroral arcs varies with the auroral forms, and is particularly pronounced for feeble homogeneous arcs. M.W.R.

N66-12775 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SIMILARITIES BETWEEN THE AURORAE BOREALIS AND AUSTRALIS

G. A. Kubo *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 140–150 refs (See N66-12765 03-13)

Similarities between northern and southern polar auroras were studied during brief periods of 16 nights in 1958 at one northern and one southern station in the U.S.S.R. Variations in diurnal and seasonal activity are plotted. It is shown that from March through the first half of April there are more and longer forms in the northern hemisphere; from September through the first half of October, this trend is true for the southern hemisphere. The course of solar activity is found to better reflect the activity of the polar auroras in the hemisphere in which auroral activity during the given half year is greater. Maximum diurnal activity from both stations is at about 2300 hours local time, but significant differences in auroral forms and their development are not observed. At both stations, polar auroral arcs follow the magnetic parallels. Auroras occurring simultaneously at both stations are very few in number; and forms and their development for simultaneously developing auroras are not necessarily identical. M.W.R.

N66-12961*# California Univ., La Jolla.

HIGH ENERGY PHOTONS AND NEUTRINOS FROM COSMIC SOURCES

R. J. Gould and G. R. Burbidge 1 Apr. 1965 95 p refs
(Grant NsG-357)
(NASA-CR-68298) CFSTI: HC $3.00/MF $0.75 CSCL 20H

The mechanisms which give rise to hard radiation in the universe are summarized. It is recognized that apart from observations of the sun, there is little observational evidence which can be used in conjunction with the theoretical estimates. It has been shown that there are sources of X-rays at flux levels which are detectable with present techniques. Moreover, the absence of a large isotropic flux of X-rays permits the establishment of limits on the temperature of the intergalactic medium. The theoretical estimates of fluxes suggest that a great increase in sensitivity of detectors as well as good resolution is required to exploit this field. Finally, the X-ray observations already have shown that the universe is not very hot and may in fact be rather cool. In this case, apart from the neutrino flux which is part of the general cosmological thermal radiation field, the flux of hard radiation may be rather weak. E.E.B.

N66-12988*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.

PROTONS AND HELIUM NUCLEI WITHIN INTERPLANETARY MAGNETIC REGIONS WHICH CO-ROTATE WITH THE SUN

C. Y. Fan, G. Gloeckler, and J. A. Simpson [1965] 16 p refs Presented at Intern. Conf. on Cosmic Rays, London, 6–17 Sep. 1965 Submitted for Publication
(Contracts NAS5-2990; NAS5-2133; AF 19(628)-2473)
(NASA-CR-68314; EFINS-65-89) CFSTI: HC $1.00/MF $0.50 CSCL 20H

From IMP-I measurements we showed in 1964 that fluxes of protons of >1 Mev energy appeared for several days in a sequence of six consecutive 27-day intervals. We concluded that these protons were confined within a region co-rotating with the sun which modulates the galactic cosmic radiation at the orbit of Earth with the same 27-day recurrence period. This region has persisted for more than 20 solar rotations and was observed with the IMP-I magnetometer by Ness and Wilcox to possess special characteristics. The energy spectrum of the protons in the leading and trailing sides of the co-rotating region was measured. A helium component continuously associated with the protons has been found with an energy spectrum of E^{-2} MeV/nucleon in the energy range 2 to 30 MeV/nucleon. Evidence from the OGO-I satellite indicates that the proton and helium fluxes are not only present within co-rotating regions, but are also present at lower intensity and with different spectra at all times throughout a 2.5 month period. The source for continual acceleration of these protons and helium nuclei is discussed. Author

N66-12988*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

OBSERVATIONS OF MAGNETOSPHERIC BOUNDARY PHENOMENA

L. A. Frank Aug. 1965 60 p refs Presented at the Advanced Study Inst. "Radiation Trapped in the Earth's Magnetic Field," Bergen, Aug. 16–Sep. 3, 1965 *Its* Rept.-65-32
(Grant NsG-233; Contract Nonr-1509(06))
(NASA-CR-68363) CFSTI: HC $3.00/MF $0.50 CSCL 20H

A brief summary of recent major observations of magnetospheric boundary phenomena is provided with emphasis on Explorers 12 and 14 and IMP 1 measurements of charged particles and of magnetic fields in the sunward magnetopause region and within the tail of the magnetosphere in the antisolar direction. Major observations of charged particles in these regions are summarized in several equatorial spatial distribution diagrams. Author

N66-13011*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.

ACCELERATION OF PARTICLES IN THE EARTH'S SHOCK TRANSITION REGION AND BEYOND

C. Y. Fan, G. Gloeckler, and J. A. Simpson [1965] 16 p refs Presented at Intern. Conf. on Cosmic Rays, London, 6–17 Sep. 1965 Submitted for Publication
(Contracts NAS5-2990; NAS5-2133; AF 19(628)-2473)
(NASA-CR-68295; EFINS-65-86) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Pulses of high energy electrons were observed in the vicinity of the bow shock of the terrestrial magnetosphere with both the Au–Si surface barrier solid state detector (the front detector of the cosmic-ray telescope of the University of Chicago) and the GM counter (University of California) on board the IMP-I satellite. These particle pulses were also detected inside the shock transition region with GM counters in earlier satellites. There is experimental evidence that these electrons are accelerated in the shock transition region. By comparing the counting rates of the solid state detector and that of the GM counter on board IMP-I, the energy spectrum of the electrons may be estimated. If the integral spectrum is expressed as $F = F_0E^{-\gamma}$, the value of γ varies from +2.5 to +4.5. Beyond the shock transition region up to the apogee of the IMP-I satellite (200 000 km), pulses of high energy particles were also observed with the Au–Si solid state detector prior to the arrival of the 27-day recurrent solar plasma of enhanced velocity. It is suggested that these are particles accelerated in space by multiple shock waves associated with the co-rotating shock front. Author

N66-13126*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AN ENVIRONMENTAL MODEL FOR VAN ALLEN BELT PROTONS

William T. Roberts 21 Oct. 1965 31 p refs

(NASA-TM-X-53351) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The radiation environment for earth orbiting vehicles will consist primarily of (1) Van Allen particles, (2) solar flare particles, and (3) galactic cosmic particles. Of these three, the Van Allen belt particles present the greatest hazard. This report summarizes the knowledge of the energy spectrum and distribution of the Van Allen proton belt as it is known today. A computer program has been developed for calculating Van Allen particles incident upon vehicles in earth orbits. Based upon the 1963 FLUX program of McIlwain, we find that a vehicle in a highly elliptic orbit may encounter as many as 1.1×10^8 protons/cm^2/orbit with 40 MeV $\leq F \leq$ 110 MeV. In the magnetic equatorial plane, the flux of protons with E $\geq$ .5 MeV may be as high as 2.2×10^7 protons/cm^2/sec. Author

N66-13141*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.

OBSERVATIONS MADE OF SUBMILLIMETER-WAVELENGTH SOLAR RADIATION USING THE MC MATH SOLAR TELESCOPE OF THE KITT PEAK NATIONAL OBSERVATORY

R. A. Williams 13 Aug. 1965 28 p refs *Its* Rept.-1093-27 (Grant NsG-74-60)

(NASA-CR-68549) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Solar radiation measurements in the region from 60 microns to one millimeter wavelength were conducted during April 1965 at Kitt Peak National Observatory near Tucson, Arizona. The manner in which these tests were conducted and the results obtained are described in this report. It was found that when the total precipitable water-vapor content in the atmospheric path from the sun to the telescope was less than about 0.2 centimeters solar radiation was observed at several atmospheric windows having wavelengths greater than 300 microns, with the maximum transmission through the window at 345 microns wavelength being on the order of two percent. The spectral data obtained under a variety of total water-vapor columns and path lengths are presented in a series of charts contained within this report. Author

N66-13226*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN INVESTIGATION OF THE INTENSITIES AND CHARGE COMPOSITION OF LOW ENERGY ELECTRONS AT BALLOON ALTITUDES

Peter Serlemitsos (M.S. Thesis—Maryland Univ. 1963) Washington, NASA, Dec. 1965 23 p refs

(NASA-TN-D-3108) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A detector has been designed and constructed for the purpose of measuring the positron-to-electron ratio at balloon altitudes as a function of electron energy, in the range from about 1 to 15 MeV. The principle of operation as well as problems encountered in design, construction and calibration are discussed. In addition, data from a recent flight over Northern Canada are presented and their implications with regard to the detector's purpose are considered. Possible ways for improving the present apparatus are mentioned along with the apparent limitations of this type of detector when used to conduct cosmic ray research at balloon altitudes. Author

N66-13296*# National Aeronautics and Space Administration, Washington, D. C.

ISOTROPIZATION OF COSMIC RAYS [OB IZTROPIZATSII KOSMICHESKIKH LUCHEY]

V. N. Tsytovich Nov. 1965 28 p refs Transl. into ENGLISH from Russian

(NASA-TT-F-9779) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The role of plasma effects in cosmic ray isotropization is studied. Two mechanisms of isotropization are considered: (a) due to the beam instability of cosmic rays; (b) due to the scattering of cosmic rays by the turbulent pulsations of plasma. It is shown that (1) large increments are developed during the initial stage of beam instability development, (2) for relativistic particles (cosmic rays) the nonlinear effects lead to the elimination of instability and the cessation of isotropization when rather small amounts of energy are transmitted from the cosmic rays into plasma oscillations, (3) isotropization due to beam instabilities is closely associated with ion motion (which is frequently controlled by gravitational forces,) and (4) the isotropization of cosmic rays due to their scattering by turbulent pulsations of the plasma is quite effective. The article considers the effects of isotropization occurring during the scattering of cosmic rays both by the high-frequency turbulent pulsations and by hydrodynamic pulsations. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-12154*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A STUDY OF GEMINI-AGENA DOCKING USING A FIXED-BASE SIMULATOR EMPLOYING A CLOSED-CIRCUIT TELEVISION SYSTEM

Donald R. Riley, Byron M. Jaquet, Richard E. Bardusch, and Perry L. Deal Washington, NASA, Dec. 1965 54 p refs

(NASA-TN-D-3112) CFSTI: HC $3.00/MF $0.50 CSCL 22A

A full-size Gemini-Agena docking study was made using a visual docking simulator to determine some of the effects on docking of spacecraft attitude control mode, control power, target lighting, and target oscillatory motion. Flights were initiated at a range of about 300 feet and were made using only visual observation of the target for guidance information. The results indicate that the spacecraft rate-command attitude control mode (primary) was well suited to the docking task. Consistent within-tolerance dockings could be obtained with the direct attitude control mode (backup), but the task was difficult and required considerable practice to become proficient. Design thrust levels for translation and attitude control jets permitted satisfactory docking operations; however, in a limited study using one research pilot one-half design thruster outputs were preferred for close-in maneuvering. Performance degradations for darkside dockings were obtained when only the docking ring was illuminated. With the addition of visual aids to provide boresight information, results comparable to daytime flights were obtained. Author

N66-12164*# National Aeronautics and Space Administration, Washington, D. C.

PIONEERS OF ROCKET TECHNOLOGY Selected Works

T. M. Mel'kumov, B. N. Vorob'yev, and V. N. Sokol'skiy, ed. Nov. 1965 165 p refs Transl. into ENGLISH of "Pionery Raketnoy Tekhniki—Kibal'chich, Tsiolkovskiy, Tsander, Kondratyuk—Izbrannyye Trudy" Moscow, Izd. "Nauka", 1964 p 1–20, 501–669
(NASA-TT-F-9285) CFSTI: HC $5.00/MF $1.00 CSCL 22A

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N66-12166* National Aeronautics and Space Administration, Washington, D. C.

TO WHOMSOEVER WILL READ IN ORDER TO BUILD

Yu. V. Kondratyuk *In its* Pioneers of Rocket Technol. Nov. 1965 p 15–56 (See N66-12164 03-30) CFSTI: HC $5.00/MF $1.00

This article written in 1916 considers such problems as the derivation of an equation for rocket flight, spaceship construction, flight conditions within the solar system, the establishment of interplanetary transfer bases, atmospheric effects on the spacecraft, utilization of solar energy for power, the limited endurance of humans, and instrumentation. E.E.B.

N66-12182*# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

PHOTOMETRIC MEASUREMENTS OF SIMULATED LUNAR SURFACES Quarterly Progress Report, Jul. 1–Sep. 30, 1965

J. D. Halajian and F. A. Spagnolo Oct. 1965 20 p refs
(Contract NAS9-3182)
(NASA-CR-65168; RM-297) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Modifications made to improve the photometric analyzer are outlined, and widening of the beam splitter to achieve a more meaningful simulation and study of the opposition effect on the moon is described. The enlarged beam splitter is used for readings near zero phase angle, with an approximate range from −7° to +13°. It is removed and replaced with a mirror for readings at larger phase angles. In an evaluation test run made on the Hawaiian volcanic cinder No. 1 at 0°, 30°, and 60° viewing angles, more accurate measurements of the brightness peak were obtained, and the change in slope of the photometric curve was revealed in the region where the opposition effect takes place, thus permitting direct comparison with the measured lunar data. The preliminary analytic approach to investigating the role of shadowing for various suspended particle configurations and contrived tridimensional models is also discussed. M.G.J.

N66-12184*# Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.

NUMERICAL RESIDUAL PERTURBATION SOLUTIONS APPLIED TO THE PROBLEM OF A CLOSE SATELLITE OF THE SMALLER BODY IN THE RESTRICTED THREE-BODY PROBLEM

J. C. Walker, M. C. Eckstein, and H. A. Holman Sep. 1965 306 p refs
(Contract NASw-901)
(NASA-CR-68122; SM-49213) CFSTI: HC $7.00/MF $1.75 CSCL 03C

A new method of numerical residual perturbation solution is applied to the problem of a close satellite of the smaller body in the restricted three-body problem. This report demonstrates the use of an analytic series perturbation solution as a reference orbit (rather then using conics as a reference) and the numerical solution of the residual (i.e., not accounted for by the analytic solution) perturbation equations of motion. The new method shows advantages over the full region of validity of the analytic reference orbit. The analytic theory of motion used is such as to limit the application of the results to orbits of small inclination and eccentricity with special initial conditions. Author

N66-12251*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SEPARATION TRAJECTORY CHARACTERISTICS RESULTING FROM SEPARATING TWO VEHICLES IN NEAR-EARTH ORBITS

Ben F. Mc Creary Washington, NASA, Dec. 1965 34 p refs
(NASA-TN-D-3069) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A parametric study was made of separation trajectory characteristics resulting when one vehicle separates from another in near-earth orbits. The separation trajectory parameters presented in this report apply to eccentric orbits with perigees of 87 nautical miles (n. mi.) and apogees up to 161 n. mi. with circular orbits up to 150 n. mi. Ballistic numbers of the active vehicle were varied between 15 and 60 lb/ft^2 and separation velocities of up to 50 ft/sec were considered. Proper selection of the separation parameters allows the two vehicles to be placed in any relative position desired. A posigrade separation will place the active vehicle behind the reference vehicle, and for certain ballistic numbers, the active vehicle will reverse position and go ahead of the other. A retrograde separation will always place the active vehicle in front of the reference vehicle, and radial separation will return the two vehicles to positions near each other in each succeeding orbit. Author

N66-12291# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 243: THE EFFECT OF THE EARTH'S OBLATENESS ON THE PERIOD OF REVOLUTION OF AN ARTIFICIAL SATELLITE

Hsien-Tzu Chao 22 Nov. 1965 18 p refs Transl. into ENGLISH from Tien Wen Hsueh Pao (Guozi Shudian), v. 12, no. 2, Dec. 1964 p 169–179
(JPRS-32969; TT-65-33546) CFSTI: $1.00

To deduce several ordinary nodal period formulas that are applicable at any parallel of declination, the parameter variable ψ (the angular travel between orbit and declination) and constant are used, with allowance made for the oblateness of the earth; the general conversion relationship of the nodal

period and the anomalistic period is also provided. The function of the earth's position and three components of perturbation acceleration are formulated, and perturbations in the radical of the satellite orbit are expressed by Lagrange's formulas from celestial mechanics. Equations for the nodal and the anomalistic periods are then derived; the final formula shows generality and provides the conversion relationship between the nodal period and the anomalistic period on any parallel of declination. Tabular data are also included on the amplitudes of change in the nodal period, and in diurnal variations of the nodal period, when period is 100 minutes. M.G.J.

N66-12405* National Aeronautics and Space Administration, Washington, D. C.
RESEARCH OPPORTUNITIES IN MANNED SPACE FLIGHT
Samuel C. Phillips *In its* NASA Univ. Program Rev. Conf. 1965 6 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

Details of the technical challenge of Apollo are indicated and some of the ideas for exploiting Apollo capability by using the developed systems for a broad spectrum of space research and experimentation are discussed. Also, it is recognized that the universities are the fountainhead of our national strength in science and technology. The importance and role of man in the space flight program are considered. Man's abilities are reviewed in four areas: as a sensor, a manipulator, an evaluator, and an investigator. Concurrently, with the Apollo program, NASA is conducting studies and planning missions using Apollo developments for missions other than the initial manned lunar landing program. With Apollo equipment, an opportunity to perform experiments that heretofore were too large, too complex, too heavy, or too power-consuming for other satellite programs is available. Some of these experiments are described. E.E.B.

N66-12412* Princeton Univ., N. J.
NASA'S CONTRIBUTIONS TO SPACE SCIENCES AND ASTRONAUTICS AT PRINCETON UNIVERSITY
Martin Summerfield *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 27 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The NASA-sponsored research in astrophysics and in aerospace propulsion and the NASA support of graduate education in space sciences and in astronautics at Princeton University are discussed. In astrophysics a broad program of astronomical observations is underway employing telescopes placed above the earth's atmosphere to accomplish better photographic definition and to make measurements in spectral regions in which the atmosphere is opaque. To supplement this observational research above the atmosphere NASA is supporting at Princeton a program of fundamental astrophysical studies, both theoretical and experimental. The aerospace propulsion program consists of static test firings of rocket engines, basic aspects of various propulsion systems, combustion of metals in gaseous atmospheres approximating the flame gas in a rocket engine, and the structure and propagation dynamics of a plasma wave created by an electrical pulse discharge and accelerated by its own magnetic field. Traineeship grants are currently supporting 24 graduate students in various fields including astrophysics, gas dynamics, aerospace propulsion, as well as others. E.E.B.

N66-12417* Minnesota Univ., Minneapolis.
SPACE FLIGHT EXPERIMENTS IN A GRADUATE PHYSICS PROGRAM
John R. Winckler *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 12 p ref (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

A number of observations on the problems and difficulties involved in using space flight experiments for Ph. D. theses are offered. One of the basic assumptions made is that the investigations will lead eventually to the solution of specific problems and will advance physical knowledge. The graduate physics program at the University of Minnesota is outlined, and the factors involved in choosing a suitable Ph. D. problem are discussed. The risks inherent in selecting a specific space experiment, in which the rocket may end up in the ocean, are stressed. It is also pointed out that a student doing research in this area must become a master of every phase of it—electronics, mechanical design, data analysis procedures, computer programming, etc. The experiences of a space physics group are also discussed. M.G.J.

N66-12511# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE FREEWAY FROM OUTER SPACE
A. Shibanov and F. Borisova 24 Jun. 1965 10 p Transl. into ENGLISH from Tekhn. Molodezhi (Moscow), no. 9, 1963 p 3–4
(FTD-TT-65-741/1+2+4; AD-620975)

A popularized account is given of atmospheric factors to be considered in space flight. TAB

N66-12563# RAND Corp., Santa Monica, Calif.
THE SPACE PROGRAMS OF THE SOVIET UNION
F. J. Krieger Aug. 1965 12 p refs Presented at the Am. Astron. Soc. Natl. Meeting, San Francisco, 18–20 Aug. 1965
(P-3204; AD-620883)

A review of the Soviet space programs is presented. As of August 3, 1965 the Soviet Union had announced 99 space launches involving 113 distinct space vehicles, including 4 doublets, 3 triplets, and 1 quintuplet. Their payloads ranged in mass from 83.6 kilograms for Sputnik I to 12.2 metric tons for Proton I. The initial Soviet space program embraced an earth orbiting manned vehicle, a hard lunar landing, and planetary probes to Mars and Venus. The latter goal has not been accomplished to date. An account of the successes and failures of some of the space flights is given, including Sputnik, Luna, Venus, Mars, Zond, Vostok, Voskhod, Cosmos, Polyot, Electron, Molniya, and Proton spacecrafts. A forecast of possible future Soviet space events including approximate dates is included. R.N.A.

N66-12614# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PROGRAM DESCRIPTION—RADAR OBSERVATIONS OF THE PLANETS
J. W. Meyer 9 Jul. 1965 45 p refs *Its* TN-1965-35
(Contract AF 19(628)-5167)
(ESD-TDR-65-309; AD-619708)

An approach to the construction of a radar employing the 120-foot Haystack antenna at a wavelength of approximately 4 cm., a transmitter capable of producing 500 Kw of average power, and a maser preamplifier for the receiver is described. The system is expected to have a threshold (signal-to-noise in a 1-cps filter) of 35 decibels. Extended integration can increase this factor by about 10 decibels. This radar performance will permit measurements on the inner planets of the solar system throughout their orbital period. Measurements on Jupiter can also be attempted, and a possible detection of Saturn is implied.

Experiments exploiting this performance are described, including the conduct of a 4th test of general relativity, the precision determination of the orbits of the inner planets, a measurement of the astronomical unit with increased accuracy, better determination of planetary masses and radii, and measurements on planetary surfaces. These measurements are not only of interest to astronomers and cosmologists but also of critical importance to the accurate guidance and navigation of vehicles in space. The roles played by the (L-band) Millstone radar tracker, and the (UHF) ionospheric radar in current space research are also briefly discussed. Author (TAB)

N66-12733*# National Aeronautics and Space Administration, Washington, D. C.
HISTORICAL SKETCH OF NASA
1965 57 p refs
(NASA-EP-29) GPO: HC $0.25; CFSTI: MF $0.50 CSCL 22A

An account of the origins and early history of NASA is presented. Discussions are included on NASA's founding, the significance of the National Aeronautics and Space Act, the transition of the National Advisory Committee for Aeronautics into NASA, integration and early growth of the NASA organization, early milestones and progress of NASA's space sciences program, Project Mercury, and NASA's long range planning. The expansion of the space program and facilities, and the resulting Mariner, Ranger and orbiting observatories, and the weather and communications satellites are described. The impact and implications of NASA's future space programs are discussed. R.N.A.

N66-12767 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PHYSICS OF INTERACTION BETWEEN RADIO WAVES AND METEOR TRAINS
I. V. Bayrachenko *In its* Collection of Articles on the IGY, Issue 2 18 Aug. 1965 p 11–45 refs (See N66-12765 03-13)

The theory of vaporization and ionization of meteors is discussed, and evaporization, ionization probability, distance, and electron density equations are included. Dissipation of meteor trains is attributed to diffusion, since the effects of recombination and adhesion are apparent only in extremely long-enduring meteors. A method of estimating the initial radii of meteor trains is evolved, and the mechanism for reflection of radio waves from meteor trains is discussed. Scattering without consideration of diffusion is discussed as is the Herlofson theory of scattering, which in some cases permits consideration of ambipolar diffusion effect. Also presented is the Kaiser and Closs theory, an approximation method which represents the electrodynamic problem as a problem in statics. It is assumed that the meteor train, which is cylindrical in shape, gradually expands due to diffusion. The maximum coefficient of reflection for an overdense train is found to be independent of the polarization of the incident wave. M.W.R.

N66-12857*# Bellcomm, Inc., Washington, D. C.
THE METEOROID ENVIRONMENT OF PROJECT APOLLO EDITION 2
G. T. Orrok 20 Feb. 1964 68 p Revised
(NASA-CR-68189) CFSTI: HC $3.00/MF $0.75 CSCL 22B

The meteoroid environment of the Apollo mission is reviewed. A model for engineering design purposes is presented. The principal inputs are the Explorer XVI penetration data, the flux mass relations for visual and radar meteors, and a modified Ames penetration equation. The zero magnitude meteor of velocity 30 km/second has a mass of one gram and a density of one gram per cc. After analysis of available data, it is estimated that the solid skin thickness required for protection to a given impact probability is known to a factor of about 2.1 times. Erosion rates as estimated from Explorer XVI data are negligible. The variation of penetration hazard among low earth orbit, deep space, and the lunar surface is thought small. Author

N66-12863*# IIT Research Inst., Chicago, Ill. Technology Center.
A HIGH ALTITUDE MEASUREMENT TO DETERMINE THE RATIO OF DEUTERIUM TO HYDROGEN IN THE SOLAR ATMOSPHERE Quarterly Status Report, 1 Jun.–31 Aug. 1965
Gordon Henderson 21 Oct. 1965 12 p
(Contract NASr-65-(13))
(NASA-CR-68240; IITRI-A6141-QR1) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The off-band suppression available with various combinations of Fabry–Perot interferometers and forefilters is under study and has resulted in a decision to design the system to comprise : (1) a 10A halfwidth forefilter centered on H_α at 6562.8A; (2) a scanning Fabry–Perot interferometer of 6A free spectral range and a finesse of 30, giving a resolution of 0.2A; and (3) a second scanning Fabry–Perot interferometer of 13.75A free spectral range and a finesse of 30, giving a resolution of 0.46A. When the instrumental function of the combination is combined with the narrow pass forefilter the result is the overall transmission of the complete system. An outline of the system to accurately measure the transmission function of the forefilter is shown. R.W.H.

N66-12865*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
EVOLUTION OF O STARS. III: HELIUM BURNING
Richard Stothers [1965] 64 p refs
(NASA-TM-X-56928) CFSTI: HC $3.00/MF $0.75 CSCL 03B

The evolution of a star of 30 $M_\odot$ is considered during the phases of helium ignition (I), depletion (He), and exhaustion (X). After the brief I-phase (1.5×10^4 years) during which the onset of helium burning halts the gravitational contraction in the core, helium is depleted in a large convective region growing outward in mass fraction until it nearly overtakes the hydrogen burning shell. Helium depletion causes a radius shrinkage until $Y_c = 0.3$, whereupon the radius re-expands. During the X-phase (1.3×10^4 years), the carbon-alpha reaction is able to sustain the luminosity in the shrinking convective core until $Y_c = 10^{-4}$. The evolutionary features of very massive stars are discussed generally, and a time scale computed for the very late phases with and without neutrino emission. In either case, the total lifetime to iron core formation will be slightly less than 6 million years. Author

N66-12869*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PARAMETRIC PERFORMANCE ANALYSIS OF LUNAR MISSIONS. PART II: LUNAR DESCENT
Charles M. Akridge and Sam H. Harlin 2 May 1963 39 p refs
(NASA-TM-X-56960) CFSTI: HC $2.00/MF $0.50 CSCL 22C

The effect of thrust-to-weight ratios, and apocenter altitude on trajectory parameters has been investigated for descent to the lunar surface from parking orbit. A single stage with constant thrust directed against the velocity vector was used in all instances. Specific impulses of 300 and 420 sec were used for comparison. The results of the study show the variation of trajectory parameters for earth thrust-to-weight ratios from 0.2

to 0.5. These parameters include: true anomaly at initiation of powered descent; change in altitude, flight path angle and range during thrusting; burning time, characteristic velocity and velocity losses. Author

N66-12930# Naval Observatory, Washington, D. C.
TOTAL SOLAR ECLIPSE OF 12 NOVEMBER 1966
Julena S. Duncombe 27 Aug. 1965 20 p *Its* Circ. No. 110

Predictions on the total solar eclipse of November 12, 1966 are presented. Included are climatological data for November; an eclipse map from the American Ephemeris and Nautical Almanac; the path of the total phase; the central line, duration and width of the path at 10,000, 20,000, 30,000, and 40,000 feet; the central line, duration, and width of path at 100, 200, and 300 km; local circumstances for points on the central line; local circumstances for geographic locations for both total and partial phase; and maps of portions of the path and of the path across South America. R.N.A.

N66-12933# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
COMPUTATION OF OPTIMAL INTERPLANETARY LOW-THRUST TRAJECTORIES WITH BOUNDED THRUST MAGNITUDE BY MEANS OF THE GENERALIZED NEWTON–RAPHSON METHOD
Paul Kenneth and Gerald E. Taylor Apr. 1965 21 p refs
(Contract AF 49(638)-1207)
(RM-273J)

The generalized Newton-Raphson method, an iterative procedure for solving nonlinear operator equations, has been extended in application to variational problems with bounded control variables. A minimum fuel interplanetary low thrust orbital transfer problem is worked out in detail to demonstrate the practical aspects of the algorithm as well as its computational effectiveness. The control variables are the thrust magnitude, limited from zero to some prescribed maximum value, and the thrust steering angle. Author

N66-12967*# Stanford Univ., Calif. Radioscience Lab.
THE BISTATIC CONTINUOUS-WAVE RADAR METHOD FOR THE STUDY OF PLANETARY SURFACES Scientific Report No. 13
G. L. Tyler Oct. 1965 23 p refs
(Grant NsG-377)
(NASA-CR-68312; SEL-65-096) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A method is proposed for obtaining radar maps of the surface of a planet. This method is based on the use of a bistatic, continuous-wave mode of radar operation between the Earth and a spacecraft orbiting the planet. If the planet is illuminated by radio transmission from the Earth, and if the orbiter samples both the illuminating wave and the wave scattered by the planet, the amplitude and phase of the scattered wave may be recovered by a comparison of the two. This information may then be processed to create a focused image of the original brightness distribution, and resolution of a few wavelengths in range and azimuth can theoretically be obtained. Evaluation of the technique indicates that it is feasible to apply it to Mars, Venus, and the Moon. Author

N66-12973*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 5, NO. 2
31 Oct. 1965 55 p
(NASA-TM-X-56997; X-537-65-217) CFSTI: HC $3.00/MF $0.50 CSCL 22C

Data on orbiting objects are presented, including the code name and catalogue number, the source, launch date, inclination, apogee and perigee, and the transmitting frequency. Data on decayed objects are also given, along with the launch and decay dates. M.G.J.

N66-12974*# California Univ., Berkeley. Space Sciences Lab.
THE ATMOSPHERE AND SURFACE OF MARS A Selective Review
D. G. Rea [1965] 67 p refs Presented at the Lunar and Planetary Seminar, Calif. Inst. of Tech., Pasadena, 17 Sep. 1965
(Contract NASr-220; Grant NsG-101)
(NASA-CR-68136) CFSTI: HC $3.00/MF $0.75 CSCL 03B

Recent significant developments in our knowledge and understanding of the Martian atmosphere and surface are reviewed. The surface pressure estimates using different techniques are roughly as follows: near infrared spectroscopy, 3 to 90 mb; ultraviolet albedo and spectrum, 3 to 30 mb. The atmospheric abundances are: CO_2, 45 m atmo; H_2O, 14μ precipitable H_2O, variable in time and space; no others detected. Of the latter two of the most important are O_2 and O_3, whose upper limits are 2 cm atm and 4μ atm respectively. The atmosphere probably contains a semi-permanent load of submicron particles (CO_2 or H_2O crystals, or dust) giving the "blue haze". The blue and white clouds are attributed to ice or CO_2 particles. The surface is characterized by bright and dark areas. The former are covered with dust which is evidently a weathering product of the dark areas. The color is attributed to the ferric ion, but its concentration relative to silicon need not be higher than the relative solar abundance. Dust storms originate in the bright areas, indicating that the local winds at an altitude of 1 meter are higher than 145 km hr^{-1}, and may be as high as 300 km hr^{-1}, or higher. The dark areas consist of maria, oases, and canals. It is suggested that the maria are extensive deposits of volcanic ash, the oases impact craters of small asteroids, and the canals loci of small volcanoes oriented along crustal cracks connecting the oases with themselves and with the volcanoes. Author

N66-12980*# IIT Research Inst., Chicago, Ill. Technology Center.
STUDIES OF LUNAR AND MARTIAN SOIL MECHANICS Third Quarterly Progress Report, Jun.–Sep. 15, 1965
E. Vey and J. D. Nelson 30 Sep. 1965 18 p refs
(Contract NASr-65(02))
(NASA-CR-68308) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Physical work from June through September 1965 centered on studies to determine shear strength parameters under vacuum, resistance of soil to dynamic penetration, and the composition of desorbed gases. Marked increases in soil stiffness were observed under ultra-high vacuum; a shear stress peak was found at approximately 0.005 in. after which it decreased and then increased again to a maximum at about 0.150 to 0.200 in. Dynamic penetration experiments with quartz and olivine powder indicated increased resistance at high and ultra-high vacuum levels. Preliminary absorption experiments on quartz crystals, quartz powder, and on olivine crystals in a heated, high vacuum container found major peaks of desorbed gas for all three materials at M/2 values of 2 and 18, probably due to desorbed H_2O from the crystals. G.G.

N66-12986*# Institute for Advanced Study, Princeton, N. J.
WAVE LENGTH DEPENDENCE OF POLARIZATION BY SMALL GRAPHITE FLAKES
J. Mayo Greenberg [1965] 11 p refs Sponsored by NASA
(NASA-CR-68373) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The extinction by oblate spheroidal particles whose complex dielectric constants are anisotropic in the sense of graphite is calculated in Rayleigh approximation. It is shown that for sufficiently small graphite flakes (maximum radius ~ .05 micron) as represented by the oblate spheroid model, and not too thick dielectric mantles, the wave length dependence of polarization may be expected to follow the curve for the wave length dependence for extinction. This is in contradiction to the observed tendency for the polarization to remain fairly constant through the visual part of the spectrum. Author

N66-12997*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
LIGHT DENSITY AND COLOR DISTRIBUTION IN THE EARTH'S SHADOW
James E. Hansen and Satoshi Matsushima Apr. 1965 49 p refs *Its* Rept.-65-12 Sponsored by NASA and NSF
(NASA-CR-68371) CFSTI: HC $2.00/MF $0.50 CSCL 03A

After taking into account the solar limb-darkening, the light density and color in the earth's shadow are computed by performing a double numerical integration over the atmosphere. Special emphasis is placed on finding an explanation for the unusual eclipse of December 30, 1963, in which an extremely low light density and an apparent non-reddening were observed. Calculations are carried out for various models of the earth's atmosphere and it is shown that dust and clouds appear to cause the non-reddening by enhancing the importance of the diffused light in the central region of the earth's shadow. It is also shown that the theory provides a conclusive means of distinguishing between extinction due to dust particles and that due to clouds. An approximate value for the amount of ozone in the atmosphere may also be determined. Author

N66-12999# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SPACE ESCAPE AND RESCUE
R. M. Strock Jun. 1965 23 p refs
(ASR-25)

Possible needs for extreme measures to save astronauts inside an orbiting spacecraft as well as in situations in which the crewmen are outside the spacecraft, were evaluated. Considered were immediate or delayed abandonment of the spacecraft through special emergency vehicles carried by the orbiting spacecraft, physical assistance from earth, and safeguarding of the men outside the spacecraft. It was found that most projected emergencies would not require drastic escape and rescue procedures. Timing, and a fast response of the rescue launch vehicle were established as critical factors in an eventual rescue mission. G.G.

N66-13009*# Bendix Corp., Ann Arbor, Mich. Systems Div.
LUNAR NAVIGATION STUDY, SUMMARY VOLUME Final Report, Jun. 1964–May 1965
L. J. Abbeduto, M. E. Amdursky, D. K. Breseke, J. T. Broadbent, R. A. Gill et al Jun. 1965 46 p
(Contract NAS8-11292)
(NASA-CR-68316; BSR-1134) CFSTI: HC $2.00/MF $0.50 CSCL 22A

Three functional navigation component configurations were investigated to determine areas in which technology research and development are required to implement lunar surface vehicle exploration missions through the 1980's. This was accomplished by deriving error models that were then used to evaluate the effects of parameter variations and also to determine navigation errors for typical operating conditions. Data resulting from the studies are applicable for use by system designers and mission planners during vehicle design and optimization phases. It was found that astronaut safety is inherent to the problem of lunar surface navigation, and safety is directly equated with navigation concept accuracy. Resolving this equation into analytical terms expresses a safe navigation system as that concept which allows the guidance or pilotage mode of homing to be effected. R.R.D.

N66-13018*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE NUMERICAL THEORY OF SATELLITES WITH HIGHLY INCLINED ORBITS
Peter Musen Washington, NASA, Dec. 1965 30 p refs
(NASA-TN-D-3084) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A numerical lunar theory which can be used to obtain the rectangular coordinates for a satellite moving in a highly inclined orbital plane is developed. The arguments of the theory are the linear functions of the true orbital longitude of the satellite and of the sun and thus are of Laplacian type. Hansen's device is employed to perform the integration and for this purpose a fictitious satellite is introduced whose true orbital longitude is considered as a constant until the integration is completed. The perturbations in the orbital plane are obtained by means of a W-function analogous to the W-function of the classical Hansen theory and the perturbations of the orbital plane carried by the vector $\bar{\Gamma}$, the unit vector of the fictitious satellite relative to the mean orbital plane. It is shown here that the combination of ideas of Laplace, Hansen, and Hill represents a convenient way to obtain a numerical lunar theory. At the same time, this work also represents a further development and a simplification of the results given by the author in his previous article. Author

N66-13020*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FEASIBILITY STUDY OF A COMMUNICATIONS SATELLITE FOR DEEP-SPACE MONITORING
George W. Clemens, Jr., Alfred C. Mascy, and Duane W. Dugan Washington, NASA, Dec. 1965 44 p refs
(NASA-TN-D-3155) CFSTI: HC $2.00/MF $0.50 CSCL 22A

The advantages and feasibility of using a single Earth-orbiting satellite to serve primarily as a communications relay between Earth and space vehicles on interplanetary missions are examined. Possible advantages over ground-based antennas for this purpose are shown to include greater information rate and/or reductions in size and weight of communications equipment and of power supplies on board interplanetary spacecraft; continuous tracking of and communication with deep space vehicles by means of only one orbiting station rather than by multiple ground-based antennas; and immunity to weather, atmospheric noise, and ionospheric disturbances. In addition, such an antenna could serve as a navigation beacon for returning manned vehicles, as a system for calibrating Earth-based radio facilities, and as a facility for radio- and radar-astronomical observations, for the search of galactic intelligence, and for radio frequency studies. A sample application of the concept to a typical manned mission to Mars is made in order to assess its feasibility. Included in the investigation of problems inherent in the use of an Earth-orbiting satellite as a communications relay station are orbit selection, attitude control, antenna reflector structures, equipment-module structure, power supply, micrometeroid and radiation shielding, propulsion systems, logistics support, and launch-vehicle requirements. Author

N66-13026# Boeing Scientific Research Labs, Seattle, Wash. Mathematics Research Lab.

THE FIGURE AND GRAVITY FIELD OF THE MOON

C. L. Goudas Mar. 1965 205 p refs *Its* Mathematical Note No. 387

The present document is an invited contribution to the "Advances in Astronomy and Astrophysics" Vol. 4. It constitutes an effort to relate all existing figure data of the Moon obtained, both from its face and its Marginal Zone, with the better known dynamical properties of the lunar body established from the study of its kinetic behavior around the center of mass. The recent contribution of the Aeronautical Chart and Information Center of the U.S. Air Force to the study of the figure of the Moon makes this work incomplete but it is hoped that an addition to the version in the "Advances" will be made during the proof stage. Author

N66-13062# Sandia Corp., Albuquerque, N. Mex.

LAUNCH HAZARDS ASSESSMENT PROGRAM, REPORT ON ATLAS/CENTAUR ABORT

F. D. Kite, D. M. Webb, B. E. Bader, and C. N. Golub (Pan-American World Airways) Oct. 1965 54 p refs

(SC-RR-65-333) CFSTI: $3.00

Information and analysis of the aborted launch of the Surveyor-mission Atlas–Centaur are presented. The system for the measurements, characteristics of the measurements, and reduction of data are included. Also, the launch vehicle is described together with meteorological data at the time of launch. The abort was characterized as producing a relatively low explosive yield in proportion to the total propellant with a high yield of thermal energy for a short time. The principal blast wave generated in this accident originated from the RP-1–LOX propellant before the fireball had grown to an estimated 50-ft radius. Temperatures in excess of 5200° F were generated at the umbilical tower sensor station for the 1- to 3-second duration of maximum fireball intensity. A description of the pad abort measuring system is also given. E.E.B.

N66-13066# Library of Congress, Washington, D. C. Aerospace Technology Div.

SOVIET SPACE EXPLORATION AS VIEWED BY EAST GERMAN SPECIALISTS Surveys of Communist World Scientific and Technical Literature

Gerhard Erleman 15 Nov. 1965 44 p refs Comprehensive Report

(ATD-65-101)

Soviet space exploration during 1960 to 1964 as viewed by East German specialists is summarized. A comparison of Soviet and Soviet-bloc sources describing Soviet space technology shows that Soviet-bloc publications often contain information of Societ space technology which has not been revealed by Soviet sources. The possible application of parallel connection of launch-vehicle stages in the Vostok-type vehicle, the surrounding of a reentry spacecraft with a magnetic field, and the bonding of metals and plastics are among the more interesting items discussed. The summary is divided into the following sections: *Soviet Space Program; Vostok-Type Spacecraft; Voskhod-1 Spacecraft; Energy Problems; Rendezvous Techniques; Military Aspects;* and *Moon Project.* A bibliography of 108 references is included. E.E.B.

N66-13077*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

OUTER ZONE ELECTRONS

Donald J. Williams [1965] 34 p refs Presented at Advanced Study Inst. "Radiation Trapped in the Earth's Magnetic Field", Bergen, 16 Aug.–3 Sep. 1965

(NASA Order R-21)

(NASA-CR-68404) CFSTI HC: $2.00/MF $0.50 CSCL 22C

This paper presents and reviews the results of an initial series of studies concerned with the observation and interpretation of the spatial and temporal behavior of high energy ($E_e \geq 280$ kev) trapped electrons in the outer zone. These observations were obtained at low altitude and high latitudes from the polar orbiting satellite 1963 38C. Using the ≥ 280 kev electron data obtained from this satellite, evidence is presented which leads to the conclusion that a few characteristic features of the behavior of the high energy electron population in the outer zone can be understood if the distorted geomagnetic field is taken into consideration. Data concerning ≥ 280 kev electrons are presented in three sections: Dayside variations which show a striking 27 day correlation in trapped electron intensities and appear to be closely related to the passage of the sector boundaries of the interplanetary field; diurnal variations which are shown to be consistent with charged particle motion, under conservation of the adiabatic invariants, in a distorted field; and storm-time variations which show that the trapped electron behavior during a main phase magnetic storm is consistent with the simultaneous behavior of the magnetic field in the earth's magnetic tail. R.N.A.

N66-13087*# Battelle Memorial Inst., Columbus, Ohio.

GRAVITY-ASSISTED TRAJECTORIES FOR UNMANNED SPACE EXPLORATION

R. F. Porter, R. G. Luce, and D. S. Edgecombe 23 Sep. 1965 50 p refs

(Contract NASw-1146)

(NASA-CR-68447; BMI-NLVP-FTR-65-1) CFSTI: HC $2.00/MF $0.50 CSCL 22C

The concept of utilizing a close encounter with another planet to modify the heliocentric trajectories of unmanned space probes has been examined. This study consisted of both a literature survey and original analytical work. The potential advantages of swingbys of Venus and Jupiter are illustrated for three classes of missions: (1) probes to the outer reaches of the solar system, (2) probes to the near vicinity or impact with the Sun, and (3) probes out of the ecliptic plane. Author

N66-13130# Philco Corp., Palo Alto, Calif. WDL Div.

INTERPLANETARY NAVIGATION AND GUIDANCE STUDY. VOLUME I: SUMMARY

30 Oct. 1965 73 p refs

(Contract NAS8-11198)

(NASA-CR-68548; WDL-TR2629) CFSTI: HC $3.00/MF $0.75 CSCL 22C

The scope of the study includes a statistical error analysis of the navigation and guidance systems for the midcourse and orbital phases of the Earth-Mars mission. A 532 day round-trip trajectory is used which is based on a 1975 launch opportunity and has high energies for both the outbound and return phases. In general, only random errors resulting from the navigation instruments and the guidance maneuvers are considered. Four navigation system configurations are evaluated under the assumption that observation data are processed with a minimum variance Kalman filter to estimate the vehicle state. Sections 2, 3, and 4 of this report summarize the navigation and guidance theory, the computer simulation, and the onboard measurement techniques that have been used in the study. The principal results are discussed in Sections 5, 6 and 7 for the outbound midcourse, the return midcourse phase, and the Mars orbital phase, respectively. Author

N66-13163*# Stanford Univ., Calif. Radioscience Lab.
LUNAR RADAR MEASUREMENTS OF THE EARTH'S MAGNETOSPHERIC WAKE Scientific Report No. 11
P. Yoh, H. T. Howard, B. B. Lusignan, and V. R. Eshleman Aug. 1965 19 p refs
(Grant NsG-377)
(NASA-CR-68539; SEL-65-085) CFSTI: HC $1.00/MF $0.50 CSCL 03A

A large number of combined Faraday polarization and Doppler frequency measurements were made on lunar radar echoes. The results of the measurements, taken while the moon was in the anti-solar quadrant, show a large spatial variation of the electron content beyond the ionosphere. A first-order model of the earth's magnetospheric wake is deduced, having the following characteristics: (1) the electron density inside the wake is about 200 cm^{-3} greater than the solar wind electron density; (2) the wake extends at least to the orbit of the moon; and (3) the wake intersects the lunar orbit at about 120° from the earth-sun line. Author

N66-13183# Control Data Corp., Minneapolis, Minn.
INFORMATION CONTENT OF PHOTOGRAPHIC STAR IMAGES
Edward J. Farrell [1965] 31 p refs Presented at 1965 Ann. Meeting Optical Soc. of Am., Philadelphia, 5–8 Oct. 1965

This paper is primarily concerned with the position measurements of weak stars. The position accuracy is determined by the star brightness, brightness of airglow and zodiacal light, magnitude of seeing, and image shape. In fact, these factors impose an intrinsic limit on the position accuracy. Explicit equations for the minimum rms position error that one can achieve are presented. This accuracy limit is compared to experimental observations on plates taken with the 48 inch Palomar-Schmidt telescope. Author

N66-13229*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A GUIDANCE SCHEME FOR LUNAR DESCENT BASED ON LINEAR PERTURBATION THEORY
Kenneth C. White and Phillips J. Tunnell Washington, NASA, Dec. 1965 40 p refs
(NASA-TN-D-3147) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A three-dimensional guidance scheme for descending from lunar orbit to a hovering position was developed and analyzed. The scheme is based on the linear theory of perturbations about a nominal reference trajectory and uses thrust acceleration and thrust orientation angles as variables in the control equations. It allows the preselection of a lunar landing site from a wide range of initial conditions and permits guidance within the rigid constraints proposed for LEM. The specific control equations are fully developed in the report. Guidance capability, the effect on guidance capability of reducing the target size, and fuel consumption are considered in detail. An analog computer was used for the investigation and the basic results were checked by means of a digital computer program. Author

N66-13240*# McDonnell Aircraft Corp., St. Louis, Mo.
ORBITAL TESTING REQUIREMENTS FOR GUIDANCE AND CONTROL DEVICES, VOLUME I
F. Hercules and R. Butler Washington, NASA, Dec. 1965 101 p refs
(Contract NASw-1067)
(NASA-CR-355) CFSTI: HC $4.00/MF $0.75 CSCL 22A

A study is presented which (a) selects the types of spacecraft guidance, navigation and control systems, and components requiring test in an actual orbital environment, (b) specifies the experiments for such devices, and (c) determines the feasibility of multiple experiments and the constraints imposed on and by feasible satellite payload configurations and support systems. It is shown that present ground testing facilities are limited or inadequate for simulations of earth signature characteristics, atmospheric attenuation effects, space radiation, multiple environments, and zero-g. The basis for selecting the included tests is given, and areas for future research are cited. C.T.C.

N66-13293*# National Aeronautics and Space Administration, Washington, D. C.
GAMMA AND X-RAY ASTRONOMY: NEW METHODS OF SPACE RESEARCH [GAMMA-I RENTGENOVSKAYA ASTRONOMIYA. NOVVYE METODY ISSLEDOVANIYA VSELENNOY]
V. L. Ginzburg and S. I. Syrovatskiy Dec. 1965 20 p Transl. into ENGLISH from Priroda (Moscow), no. 3, 1965 p 50–58
(NASA-TT-F-9450) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The basic principles of gamma ray and X-ray astronomy are discussed. Also, the production of gamma rays by electron–positron annihilation, Compton effect, atomic transitions, meson decay, and electron–nucleus collisions are considered. Further, cosmic X-radiation and X-ray stars are described. It is observed that gamma astronomy and X-ray astronomy are in a nascent stage. Few experiments have been conducted; however, these very first experiments attest that a new and exceedingly promising method of space research has begun. E.E.B.

N66-13299*# Consultants and Designers, Inc., Arlington, Va.
VERIFICATION OF A HYPOTHESIS CONCERNING THE TYPE-3C273 RADIOSOURCE [VERIFICATION D'UNE HYPOTHESE CONCERNANT LES RADIOSOURCES DU TYPE 3C273]
Marin Kalinkov and Lubomic Sadowsky 3 Dec. 1965 7 p refs Transl. into ENGLISH from Compt. Rend. (Paris), v. 260, 10 May 1965 p 4917–4920
(Contract NAS5-3760)
(NASA-TT-F-9912) CFSTI: HC $1.00/MF $0.50 CSCL 03B

This is a statistical verification of the hypothesis according to which the sources of energy produced from type-3C273 radiosources are stars exploding as supernovae. Brightness observations of 3C273 allow to obtain the number N of stars that explode per day, $0.5 < N < 1$. Author

N66-13300*# Consultants and Designers, Inc., Arlington, Va.
ON SOME CHARACTERISTICS OF RADIO EMISSION SOURCES CONNECTED WITH THE ACTIVE REGIONS OF THE SUN [O NEKOTORYKH KHARAKTERITIKAKH ISTOCHNIKOV RADIOIZLUCHENIYA SVYAZANNYKH S AKTIVNYMI OBLASTYAMI NA SOLNTSE]
A. R. Abbasov 14 Dec. 1965 5 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad.), v. 4, no. 14, 1965 p 140–142
(Contract NAS5-3760)
(NASA-TT-F-9913) CFSTI: HC $1.00/MF $0.50 CSCL 03B

This is a preliminary communication on some of the characteristics of radio emission sources connected with the active regions of the Sun. The present observations were conducted during low solar activity. We utilized for their processing the results of observations at IHH and Nagoya stations; they allowed to conclude that a decrease in the S-component of radiation flux is observed prior to intense radiobursts but the flux increases after the bursts, since the sources linked with sunspots are directional. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N66-12167* National Aeronautics and Space Administration, Washington, D. C.
THE WORKS OF THE RUSSIAN SCIENTIST-PIONEERS OF ROCKET TECHNOLOGY (HISTORICAL OUTLINE)
V. N. Sokol'skiy *In its* Pioneers of Rocket Technol. Nov. 1965 p 125–155 refs (See N66-12164 03-30) CFSTI: HC $5.00/MF $1.00

The history of the development of rocket technology in Russia is outlined from 1849 when Treteskiy developed the concepts for three lighter-than-air vehicles. These three machines were categorized as steam, gas, and air machines. The writings of Treteskiy are considered as the first scientific effort in Russia to solve the problem of utilizing the reaction propulsion principle of rocket flight. Major contributions of Russian scientists and engineers in the nineteenth and twentieth centuries are outlined. E.E.B.

N66-12378# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.
PROJECT ANNA OPTICAL OBSERVATIONS
Paul H. Dishong and George Hadgigeorge Mar. 1965 110 p refs *Its* Environment. Res. Papers No. 92
(AFCRL-65-195; AD-613938)

Optical observations of the first geodetic satellite (ANNA) have been made since shortly after launch of the satellite. After 27 months, active observations are still being made. This report contains all of the reproducible optical observations made between 9 November 1962 and 20 January 1964 by the USAF, USC and GS, USNO and NASA. In addition, the SAO Baker-Nunn active and passive observations made during November and December 1962 are listed. Brief descriptions of the satellite, the optical beacon, and some of the problems that have arisen during data reduction are presented. Some recommended changes to optical system and data reduction procedures are included. Author(TAB)

N66-13002# Sandia Corp., Albuquerque, N. Mex.
LAUNCH HAZARDS ASSESSMENT PROGRAM. REPORT ON ATLAS/CENTAUR ABORT
F. D. Kite, D. M. Webb, B. E. Bader, and C. N. Golub Oct. 1965 55 p refs Sponsored by AEC Prepared Jointly with Pan Am. World Airways
(SC-RR-65-333) CFSTI: $3.00

The purpose of this report is to summarize as completely as possible all the information and analysis concerning the aborted launch of the Surveyor-Mission Atlas-Centaur, March 2, 1965. The information and analyses contained in this report will be used in conjunction with theoretical analysis, empirical data from planned tests, and additional data from field measurements to generate a model of an explosion to be expected from a catastrophic pad-abort. The data in this report are the first contribution of field measurements to the over-all data which are required to complete the explosion model. The first three sections of this report contain a general discussion of the system with which the measurements were taken, the characteristics of the measurements, and the reduction of these data. The fourth section describes the launch vehicle and presents all the relevant data (meteorological, time, etc.) at launch; it concludes with a sequence of events which starts at first vernier engine ignition and ends 1 hour later. The fifth section describes the instrumentation configuration and system performance during the accident. The sixth section reviews the analysis of the data, and the seventh section presents the conclusions and recommendations based on the results of this accident and on the experience gained in PAMS operation. A description of the Pad Abort Measuring System is given in Appendix A. Author

N66-13238*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
PEGASUS SATELLITE MEASUREMENTS OF METEOROID PENETRATION (FEBRUARY 16–JULY 20, 1965)
Robert J. Naumann Washington, NASA, Dec. 1965 24 p refs Presented at the Intern. Symp. on Meteoroid Orbits and Dust, Cambridge, Mass., 9–13 Aug. 1965
(NASA-TM-X-1192) CFSTI: HC $1.00/MF $0.50 CSCL 22B

The Pegasus satellites deploy 200 m^2 of three thicknesses of Al instrumented to detect punctures resulting from meteoroid impingement. The determination of three points on a frequency of penetration vs. thickness of aluminum curve for thicknesses approaching useful spacecraft skin is directly applicable to spacecraft design problems. The design and operation of the meteoroid experiment is discussed briefly. The results are seen to essentially agree with ground-based predictions for the thicker materials, and with other satellite measurements for the thinnest material. Also, some temporal variations in frequency are observed and possible correlations of these variations with known showers are investigated. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-12160*# Kaman Aircraft Corp., Bloomfield, Conn.
ANALYTICAL RESEARCH ON A SYNCHRONOUS GYROSCOPIC VIBRATION ABSORBER
William G. Flannelly and John C. Wilson Washington, NASA, Dec. 1965 84 p refs
(Contract NASw-855)
(NASA-CR-338) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The feasibility of a synchronous dynamic vibration absorber based on gyroscopic resonance is demonstrated analytically and experimentally. The linearized equations of motion are solved for response of the body to which the absorber is attached as a function of excitation frequency, gyro speed, excitation force, and gyro configuration characteristics. A method of solving the nonlinearized equations is presented. Because of the excitation synchronization possible, the superiority of the gyroscopic absorber over the conventional Frahm absorber is demonstrated. For a parallel arrangement of two gyroscopic absorbers, one damped and one undamped, both an undamped antiresonant frequency and a damped resonant frequency are obtained. The effects of elastic restraint, damping, and flexibility in the support structure were examined analytically. Analysis indicates the feasibility of simultaneous synchronization of an absorber to two excitation frequencies and isotropic absorption in the plane of rotation. Author

N66-12161*# Measurement Analysis Corp., Los Angeles, Calif.
THE MAXIMUM RESPONSE OF A LINEAR MECHANICAL OSCILLATOR TO STATIONARY AND NONSTATIONARY RANDOM EXCITATION
R. L. Barnoski Washington, NASA, Dec. 1965 56 p refs
(Contract NAS5-4590)
(NASA-CR-340) CFSTI: HC $3.00/MF $0.50 CSCL 20K

This report considers the peak response behavior of a mass excited, linear mechanical oscillator when the applied random excitation is either stationary or nonstationary. The stationary random excitation is Gaussian bandwidth limited white noise and the nonstationary random excitation is Gaussian bandwidth limited white noise shaped in time by (1) a rectangular envelope function or (2) a half-sine envelope function. Thus, the nonstationary excitation appears as a pulse of white noise shaped as either a rectangle or a half-sine. Using data from an analog computer study, two topics are explored in detail: (1) the expected maximum peak response in a finite time interval for a specific probability of occurrences, and (2) a measure of the time duration for the oscillator to achieve stationarity in its response. For both stationary and nonstationary excitations, the peak behavior is noted to be dependent on the oscillator damping for a small number of response cycles. As the number of response cycles becomes larger, the peak to rms response behavior tends to become independent of damping. Author

N66-12180# Catholic Univ. of America, Washington, D. C. Stress Analysis Labs.
EXPERIMENTAL DETERMINATION OF STRESSES AND STRAINS IN A RECTANGULAR PLATE BONDED ON THE TWO LONG EDGES AND SUBJECTED TO BIAXIAL RESTRAINED SHRINKAGE Progress Report No. 4
A. J. Durelli, V. J. Parks, and P. Bhadra Oct. 1965 28 p refs
(Contract AF 04(611)-10378)
(AD-472573)

Two long edges of a rectangular plate are bonded to a rigid frame. Shrinkage of the plate is completely restrained longitudinally, and partially restrained transversally. The stresses and strains are determined by using photoelasticity.
Author (TAB)

N66-12243*# California Univ., Los Angeles. Dept. of Engineering.
OPTIMUM DESIGN OF CORRUGATED WIDE COLUMNS
M. H. Magie and C. H. Steinberg Sep. 1965 36 p refs *Its* Rept.-65-37
(Grant NsG-423)
(NASA-CR-68103) CFSTI: HC $2.00/MF $0.50 CSCL 20K

In the optimum design of wide columns made of trapezoidal corrugations, the cross section was arranged so that the two governing modes of failure occurred at the same load. Equations are given for the two modes considered: the Euler–Engesser, or general buckling of the panel element. The variation of the two buckling stresses, as the panel width is varied, is depicted. Parameters related to unit width are used, together with a structural index as a measure of the loading intensity. Twenty-six tests were conducted on the 60° corrugated columns and results showed good agreement with theory, although some scatter was evident. The predicted variation in optimum stress between the 60° and 90° columns was not conclusively demonstrated, due to experimental errors and differences in fabrication. Data are also included on the effect of standard sheet thickness upon column weight. M.G.J.

N66-12245*# Northrop Space Labs., Huntsville, Ala. Research and Analysis Section.
DYNAMIC STABILITY OF A FLEXIBLE BOOSTER SUBJECTED TO A GIMBLED, PERIODICALLY-VARYING END THRUST Technical Memorandum No. 104
J. L. Hill, C. M. Pearson, G. C. Kao, J. H. Kincaid, and A. D. Merville Oct. 1965 113 p refs
(Contract NAS8-11255)
(NASA-CR-68104; E20-118) CFSTI: HC $4.00/MF $0.75 CSCL 20K

Progress in the analysis of the dynamic structural behavior of a large rocket booster synthesized by two thin-walled cylinders is reported. It was assumed that the edges of the cylindrical models were attached to rigid, weightless bulkheads incapable of transmitting end moments to the shell. Deflection forms were obtained for the natural frequencies of the free-free, thin-walled, circular, cylindrical shells, and also for unstable values of thrust frequency for certain longitudinal and circumferential modal configurations of each circular, cylindrical shell. G.G.

N66-12262*# National Aeronautics and Space Administration, Washington, D. C.
REDUCTION OF STRESS CONCENTRATION IN A PLATE OF UNLIMITED DIMENSIONS WITH ANGULAR NOTCHES [O SNIZHENII KONTSENTRATSII NAPRAZENIY V PLASTINKE NEOGRANICHENNYKH RAZMEROV S UGLOVYMI VYREZAMI]
D. L. Chernyavskiy Dec. 1965 8 p refs Transl. into ENGLISH from Prikl. Mekhan., Otd. Mat., Mekhaniki, i Kibernetiki, Akad. Nauk Ukr. SSR, v. 1, no. 2, 1965 p 134–138
(NASA-TT-F-403) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Reduction in stress concentration in a plate with angular notches, by modifying the continuity of the notch without changing the radius of curvature, is attempted on a plate of infinite dimensions with a quasi-square hole. For a plate extended along the Ox axis by uniformly distributed forces, the reduced contour conditions for the opening are mathematically derived and the maximum stress along the contour is calculated. A reduction in maximum stress by 20% was obtained by optimizing the contour. Author

N66-12296# Massachusetts Inst of Tech., Cambridge. Dept. of Civil Engineering.
BEHAVIOR OF FLEXIBLE UNDERGROUND CYLINDERS Technical Report, 1 Mar. 1964–2 Apr. 1965
Ulrich Luscher Kirtland AFB, N. Mex., AF Weapons Lab., Sep. 1965 69 p refs
(Contract AF 29(601)-6368)
(AFWL-TR-65-99; AD-621145)

An investigation was made of the "elastic" behavior and failure condition of underground flexible cylinders with particular attention given to arching, deformation and buckling. Active arching was found to reduce the load acting on tubes buried at depths up to several diameters in stiff soil by an average of 30 percent. On the other hand, passive arching may subject tubes buried in compressible soil to loads somewhat higher than applied on the surface. Spangler's deformation equation was modified to account for arching, lateral pressures, and variability of the soil modulus with pressure. Values of the modified modulus of passive soil resistance, backcalculated by the new equation from tube deformation data, were successfully related to the constrained modulus of the soil. A comprehensive theory of buckling of underground cylinders is presented. It starts with the previously derived theory for elastic buckling in the circular-symmetric tube-soil configuration and extends it to

cover (1) elastic buckling of an underground cylinder; (2) inelastic buckling; (3) the effects of soil stiffness and presence of water; and (4) buckling of corrugated cylinders. It proved possible to correlate the soil modulus K_s controlling buckling to the constrained modulus M of the soil. Author

N66-12363# Brown Univ., Providence, R. I. Div. of Engineering.
MODE APPROXIMATIONS FOR IMPULSIVELY LOADED RIGID PLASTIC STRUCTURES
J. B. Martin and P. S. Symonds May 1965 58 p refs
(Contract N189(181)-57827A(x))
(BU/DTMB/6; AD-621580)

An attempt is made to provide a rational method of constructing one degree of freedom approximations for impulsively loaded metal structures which are analysed according to an elementary rigid-plastic theory. The approximation follows automatically from a chosen mode shape, and a criterion for determining good mode shapes is introduced. Author (TAB)

N66-12390# Measurement Analysis Corp., Los Angeles, Calif.
RANDOM FATIGUE TEST SAMPLING REQUIREMENTS
Technical Report, Feb. 1964–Apr. 1965
S. C. Choi and L. D. Enochson Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1965 73 p refs
(Contract AF 33(615)-1314)
(AFFDL-TR-65-95; MAC-2402-02A; AD-622086)

Basic considerations are discussed for determining sample sizes and record lengths for various statistical tests and estimates which are important to random fatigue testing. Methods for determining minimum sample sizes when comparing means and variances of normally (Gaussian) distributed random variables are described. Procedures for reducing a relatively large sample to a smaller sample are presented. Elimination of outliers and systematic resampling are two methods given. An explanation is presented of the requirements and problems involved in the determination of record lengths necessary for an estimate of a given accuracy for autocorrelation functions, ordinary power spectral density functions, cross-correlation functions, cross-spectral density functions, frequency response functions, and probability density functions. Due to its importance in random fatigue testing applications, the basic properties of the Weibull distribution in terms of its parameters and the failure rate are summarized. A presentation is given of estimation and statistical testing problems related to the Weibull distribution. The best available methods of estimating the parameters are described. Methods of determining sample sizes needed for various analyses are developed. Some problems of realiability analysis applicable in fatigue testing are discussed. New methods of decision techniques for comparing two or more systems are proposed in terms of reliability. The report concludes with an example of the application of the Weibull distribution to actual fatigue test data. Author (TAB)

N66-12394# Measurement Analysis Corp., Los Angeles.
TESTS FOR RANDOMNESS, STATIONARITY, NORMALITY AND COMPARISON OF SPECTRA
Julius S. Bendat, Loren D. Enochson, Allan G. Piersol Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1965 51 p refs
(Contract AF 33(615)-1314)
(MAC-402-03A; AFFDL-TR-65-74; AD-621906)

This report contains material for carrying out certain practical tests for randomness, stationarity, and normality of physical data, as well as details on how to test for equivalence of two power spectral density functions. The tests for randomness are qualitative inspections of measured properties from sample records, such as power spectra, probability density, auto-correlation functions, which may be part of a regular data reduction procedure. The tests for stationarity are nonparametric statistical procedures, based upon Run and Trend Distributions, which require simple quantitative calculations for acceptance or rejection. The test for normality is a statistical hypothesis test based upon sample measurements of the amplitude probability density function at seven equispaced amplitude levels from zero to plus and minus three sigma. To test for equivalence of two spectra, a straight-forward procedure is recommended which requires knowledge only of the number of degrees-of-freedom associated with the spectral estimates, and the full bandwidth occupied by the data. A special case of this procedure is to compare an unknown spectrum to a 'white' spectrum. Author (TAB)

N66-12430# Deutsche Forschungsanstalt fur Luft-und Raumfahrt, Brunswick (West Germany). Institut fur Flugzeugbau.
THERMAL STRESSES IN AN INFINITELY LONG ORTHOTROPIC PLATE [WARMESPANNUNGEN IN EINER UNENDLICH LANGEN ORTHOTROPEN SCHEIBE]
W. Thielemann and M. Esslinger May 1965 46 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-33) CFSTI: HC $2.00/MF $0.50

A computing method is developed for the determination of thermal stresses in an infinitely long orthotropic plate strip uniformly heated along a rectangular field. The application of this method is shown by numerical examples. Author

N66-12432# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE MODERN CONCEPTION OF ELASTIC-PLASTIC LONGITUDINAL BENDING
Ia. G. Panovko [1962] 11 p refs Translation

Theories on the question of the critical force in the inelastic domain are reviewed, and inconsistencies in these concepts are pointed out. The more recent Shanley conception of elastic-plastic longitudinal bending showed that the Engesser–Karman–Southwell theory did not exhaust the problems, and established that this bending starts at a force calculated by the Euler formula with the insertion of the tangential but not the reduced modulus. Inaccurate statements on this concept are examined to show that its acceptance is not always based on a correct understanding of the peculiarities of elastic-plastic longitudinal bending. An analysis of the problem of eccentric compression of a rod beyond proportionality limits is presented to establish the practical importance of the Shanley conception. M.G.J.

N66-12433# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON A METHOD OF SOLVING PLATE AND SHELL STABILITY PROBLEMS
I. M. Dunaev [1964] 9 p refs Translation

A method of solving partial differential equations based on the use of polynomials is proposed, for application to the problems of stability and strength of plates and shells. Equations are formulated for the boundary layer problem of a rectangular domain. It is shown that the sequence of polynomials converges uniformly to any continuous function in the closed rectangular domain; the derivative of the sequence of polynomials converges uniformly to the derivative of the function if the derivative exists and is continuous also in the closed rectangular domain. The method is also applicable when the

domain in which the solution is sought is a circle, sector, ring or part of a ring bounded by two arcs and two radii. Another method, based on the use of these polynomials, is also presented for determining the eigenvalues and eigenfunctions. It is pointed out that both methods may be used for different problems with differential as well as integral equations. M.G.J.

N66-12434# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON DYNAMIC PROBLEMS OF THE STATISTICAL THEORY OF STABILITY OF ELASTIC SYSTEMS
V. M. Goncharenko [1963] 7 p refs Translation

The influence of random strong perturbations on the stability of an elastic system possessing two Liapunov-stable equilibrium states was studied. Only dynamic force perturbations were considered for which it was impossible to neglect the inertia of the system motion. A system of differential equations were used to describe the motion of the elastic system. It was assumed that the determined leadings are such that the system, in addition to the unperturbed equilibrium state, has a stable perturbed equilibrium state outside a finite neighborhood of the perturbed state. The length of the time interval up to the first transition into the perturbed state might be a characteristic of the passage of the system into the perturbed state with subsequent vibrations under the effect of the perturbations. A method, used in investigating automatic control systems and vibrations of elastic systems, is presented for studying the perturbation effect. Various degress of approximation are also considered as approaches to solving the problem. M.G.J.

N66-12475# Aeronautical Research Council (Gt. Brit.)
ON THE SHEAR FLEXIBILITY OF TWISTED PANELS
S. Kelsey and D. F. Pilkington (Imperial Coll. of Sci. and Technol.) London, HMSO, 1965 22 p refs Supersedes ARC-25795
(ARC-R&M-3391; ARC-25795) HMSO: 9s

A simple theoretical analysis is given for the additional shear flexibility of a twisted panel caused by bending of the panel under a shear loading. Results of some experiments on initially twisted sandwich panels show good agreement with the theory. Author

N66-12502*# National Aeronautics and Space Administration, Washington, D. C.
STRESSES NEAR AN ELLIPTIC HOLE SUBJECT TO OSCILLATING PRESSURE [NAPRYAZHENIYA OKOLO ELLIPTICHESKOGO OTVERSTIYA, PODVERZHENNOGO OSTSILLIRUYUSHCHEMU DAVLENIYU]
V. D. Kubenko Dec. 1965 8 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 1, no. 5, 1965 p 133–137
(NASA-TT-F-9795) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An analysis is made of the stressed state of a thin infinite plate with a nearly circular hole having a time-variable pressure applied to the edges of the hole. A solution is obtained using a modification of the "perturbed boundary shape" method, proposed by Savin and Guz' for the solution of static problems of stress concentration near noncircular holes in elastic shells. Using this method, the problem is reduced to the solution of two Helmholtz equations. It is shown that at certain frequencies, the stress concentration is higher by 15 to 20 percent than in the static case. Author

N66-12521# Air Force Systems Command, Edwards AFB, Calif. Air Force Rocket Propulsion Lab.
INCORPORATION OF FRACTURE INFORMATION IN SPECIFICATIONS
William F. Payne]1964] 55 p refs Presented at the Symp. on Fracture Toughness Testing and its Appl., Am. Soc. for Testing and Mater., Chicago, 23–24 Jun. 1964
(AD-621840)

The problem of fracture tests is examined for material and process specifications and the use of fracture toughness information is discussed in specifications for hardware acceptance, such as nondestructive inspection specifications. Emphasis is placed on the need to design properly a fracture specimen to achieve maximum use of the information obtained. The use of subsized specimens of qualitative treatment of fracture data simply reduces the ability to effectively apply test data through the design and quality control aspects of the fracture analysis cycle. A simplified analysis is presented to show the predicted effect of crack geometry variations and crack interaction effects on crack size to produce an 'equivalent crack size' effect on fracture strength of a material. TAB

N66-12526*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRESS-INTENSITY FACTORS FOR THREE-POINT BEND SPECIMENS BY BOUNDARY COLLOCATION
Bernard Gross and John E. Srawley Washington, NASA, Dec. 1965 15 p refs
(NASA-TN-D-3092) CFSTI: HC $1.00/MF $0.50 CSCL 20K

A boundary-value-collocation procedure was applied to the Williams stress function to determine values of the stress-intensity factor K for single-edge cracks in rectangular-section specimens subjected to three-point bending. The results are presented in terms of the dimensionless quantity $Y^2 = K^2B^2W^3/M^2$ where B and W are the specimen thickness and depth and M is the bending moment at midspan. The values of Y^2 as a function of relative crack depth a/W for three-point bending are appreciably lower than the corresponding values for pure bending (determined previously by the same method) and decrease as the ratio of support span to specimen depth S/W decreases. Plots of Y^2 against a/W are given for values of a/W up to 0.5 and S/W equal to 4 and 8. The results were relatively insensitive to variations in the spread of the midspan load contact region, which was assumed to be related to the yield strength of the material. The results agreed fairly well with published results derived from experimental compliance measurements; one set gave higher values of Y^2 than the present method, and the other set gave lower values. The plane-strain fracture toughness measurement capacity of three-point bend specimens is somewhat lower than that of four-point bend specimens, but the difference is of neglibible practical importance. Author

N66-12531*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOCAL PLASTIC STRESSES IN SHEET ALUMINUM-ALLOY SPECIMENS WITH STRESS-CONCENTRATION FACTOR OF 2 UNDER CONSTANT-AMPLITUDE LOADING
John H. Crews, Jr. Washington, NASA, Dec. 1965 24 p refs
(NASA-TN-D-3152) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Cyclic plastic stresses at notch roots in specimens under constant-amplitude repeated tension and reversed loading have been studied experimentally. The applied loads were cycled in edge-notched 2024-T3 aluminum-alloy sheet specimens, which had a stress-concentration factor of 2, until local stress conditions stabilized. Determination of local stress histories was made by recording local strain histories during cycling and reproducing these histories in simple unnotched specimens. The fatigue lives for the notched specimens were estimated from the stabilized local stresses and fatigue data for the unnotched

specimens. These estimations compared favorably with fatigue-life data for the notch configuration tested. In addition, an expression for calculating local first-cycle plastic stresses is presented. An acceptable correlation is shown between predicted stresses and experimental data within the scope of the investigation. Author

N66-12579# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
THE BIOSATELLITE FOREBODY MAXIMUM RE-ENTRY PRESSURE TEST Final Report
S. R. Mc Clure 19 Jul. 1965 14 p refs
(DOC.-65SD739)

A specially machined Biosatellite forebody was heated to 245° F and subjected to simulated aerodynamic re-entry pressures. At 250° of design load there was no evidence of failure. Author

N66-12587# Lowell Technological Inst. Research Foundation, Mass.
EFFECTS OF EXTERNAL FORCES (TRANSIENT AND PERMANENT) First Quarterly Report, 1 May–31 Jul. 1965
Charles R. Mingins, Robert W. Perry, and Luther C. Barcus [1965] 63 p refs
(Contract DA-28-043-AMC-01240(E))
(Rept.-17; AD-621739)

Investigations were made of the reactions of a vibrating piezoelectric crystal plate to the application of external forces and torques, including the possibility of transient effects. Experiments are reported dealing with the effects of the superposition of forces and of combinations of forces. The results of applying considerably larger tensile forces than any previously used are discussed. Further work on the effects of torsional stresses about various axes is reported. Arrangements for setting up shearing stresses are being developed. A report of further advances in the theory in terms of nonlinear behavior is included. Author(TAB)

N66-12599# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS IN ELASTICITY AND PLASTICITY Collection of Articles, Collection 3
L. M. Kachanov, ed. 27 Aug. 1965 340 p refs Transl. into ENGLISH of the book "Issledovniya po Uprugosti i Plastichnosti" Leningrad, Izd. Leningr. Univ., 1964 p 1–272
(FRD-MT-64-533; AD-621063)

The articles consider certain questions of the theory of plasticity, two- and three-dimensional problems of the theory of elasticity, statics and oscillations of thin shells, fracture of solid bodies, an optical method of investigation of stresses and strains in metals, bimetal articles and anisotropic laminated plastics. Author(TAB)

N66-12824# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
COMPUTER ANALYSIS OF PLANE FRAMES
H. B. Harrison Jul. 1965 47 p refs
(Contract Nonr-610(03))
(Rept.-297.15; AD-619775)

A detailed description is given of a computer program to carry out a general first order elastic analysis of any type of plane frame. It is capable of analyzing pinned or rigidly jointed frames, or mixtures of both systems. Shear and axial deformations may be taken into account in rigidly jointed frames. In addition, strains caused by temperature changes, shrinkage or lack-of-fit can be allowed for with little extra effort in data preparation. The source program has been written in the Fortran language so that it can be used on most currently available computers. Analysis is carried out by the displacement method so that considerations of frame redundancy do not arise. For a given machine there will be a maximum size of structure that can be accommodated, depending primarily upon the number and type of its members, the degrees of freedom of the frame, and the number of alternative load sets for which an analysis is desired. The program was developed to check the elastic behavior of a series of braced and unbraced multi-story steel frames being tested in the Fritz Engineering Laboratory of Lehigh University's Department of Civil Engineering as part of a program of research into the plastic behavior and design of multistory steel frames. Author(TAB)

N66-12887# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
EVALUATION OF STRESSES IN WEB-STIFFENED CYLINDRICAL SANDWICH SHELLS SUBJECTED TO UNIFORM EXTERNAL PRESSURE
James A. Nott and Gerald D. Ward Sep. 1965 16 p refs
(DTMB-2092; AD-622196)

Four cylindrical web-stiffened sandwich models were tested under external hydrostatic pressure. Experimental strains were recorded on both outside and inside shells and compared with theoretical strains computed from existing formula developed at the David Taylor Model Basin. The differences between experimental and theoretical results were within the range of experimental error. Author(TAB)

N66-12891# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
ULTIMATE STRENGTH OF LONGITUDINALLY STIFFENED PLATE PANELS SUBJECTED TO COMBINED AXIAL AND LATERAL LOADING
Jun Kowdo Aug. 1965 189 p refs
(Contract Nobs-90041)
(Rept.-248.13; AD-621489)

The report presents results of an analytical investigation of the ultimate strength of longitudinally stiffened plate panels. The load considered were the axial load applied to the ends and the hydrostatic pressure acting on the plate surface. Under these external loads, longitudinally stiffened plate panels fail due to excessive bending and can be treated as beam-columns if local buckling of the plate components is prevented. The analysis was performed by solving the equilibrium equations numerically. Consideration was given to the nonlinear effects of both the inelastic action and deformation. The factors which have an effect on the ultimate strength were found to be: (a) Yield stress of material, (b) Residual stresses in both magnitude and distribution, (c) Ratio of stiffener cross-sectional area to plate area, (d) Ratio of stiffener flange area to stiffener area, (e) Ratio of stiffener depth to plate thickness, (f) Intensity of hydrostatic pressure. In the nondimensionalized Ultimate Axial-Load–Lateral Load-Panel Length relationship, the interelation between these geometric ratios was found to be practically negligible. Author(TAB)

N66-12956# Ilikon Corp., Natick, Mass.
TECHNIQUES FOR TESTING MATERIALS IN ULTRAHIGH VACUUM
Paul R. Gould [1964] 16 p refs Presented at Fall Meeting of the Am. Phys. Soc., New England Section, Amherst, Mass., 17 Oct. 1964
(AP564G)

A 20 cubic foot volume ultrahigh vacuum system with an equilibrium pressure of about 1×10^{-11} torr was used for testing materials in this environment. High temperature tensile tests, alloy powder heat treatment, friction studies on dry lubricants, and weight loss measurements were performed. Some details of the experimental techniques are given, and a discussion of methods is presented. Author

N66-12970# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
THE EMBRITTLING EFFECT OF SMALL ELASTIC STRESS WAVES ON CRACK TOUGHNESS IN A STRUCTURAL STEEL
Alan Kent Shoemaker Sep. 1965 60 p refs
(Contract AISI-44-22-60-384)
(T&AM-284)

The reduction in static crack toughness, as measured by fracture mechanics was studied in an A 201B structural grade steel for the embrittlement caused by small amplitude elastic stress waves superimposed on the static stress state of an edge notched 3/4 in. thick specimen. The stress waves were generated by five different methods of impacting the edge of the specimen on the side opposite to the crack tip when a static load existed on the specimen. The data showed a reduction of 23% in the static K_{Ic}* over a temperature range of −220° F to −180° F when the specimen was impacted by a 1.312 in. diameter steel ball, 12 in. steel bar or hammer. A maximum transient tensile strain of 37.5μ in./in. normal to the crack was shown to cause crack extension. This transient strain was measured before and during the fracture test by high resistance strain gages fixed to the specimen ahead of the crack tip. A discussion of the waves measured in a long rod and a large plate is given in order to interpret the transient strain recordings made on the specimen. A four-point bending specimen was fractured by this method of embrittlement to show that this phenomenon is not just peculiar to one specimen geometry. Author

N66-12976*# Alabama Univ., University. Bureau of Engineering Research.
COMPARISON OF SEVERAL ANALYTICAL SOLUTIONS TO THE SHEAR LAG PROBLEM WITH EXPERIMENTAL DATA
Progress Report No. 5
Dennis M. Rigsby Aug. 1965 84 p refs
(Contract NAS8-11155)
(NASA-CR-68364) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The stress distribution in a flat stiffened panel under axial load was investigated with consideration of the involved shearing strains. Several existing analytical solutions to the shear lag problem were discussed and applied to a panel with particular properties and loading conditions. Results of the various theoretical calculations were compared to experimental data for the same panel in order to find the best method of shear lag analysis. For the particular case of stress distribution in a flat stiffened panel, having constant skin thickness and equally spaced stiffeners of constant area, a matrix method solution evolved as best analytical method. This analysis assumed that the stiffeners transmit only normal stress, the sheet material transmits only shearing stresses, and the panel and loading were symmetrical. G.G.

N66-13021*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TEST OF A TRUSS-CORE SANDWICH CYLINDER LOADED TO FAILURE IN BENDING
James P. Peterson and James Kent Anderson Washington, NASA, Dec. 1965 30 p refs
(NASA-TN-D-3157) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Results of a buckling test of a 10-foot-diameter (3-m) truss-core sandwich cylinder loaded in bending are presented. The cylinder failed as a result of the growth of wall buckles; some of the buckles existed as initial imperfections in the cylinder wall prior to testing. Failure occurred suddenly at a load corresponding to approximately 62 percent of the load computed with the use of classical small-deflection buckling theory. Author

N66-13023*# Whittaker Corp., San Diego, Calif.
RESEARCH ON AN EXPANDABLE AIRLOCK UTILIZING THE ELASTIC RECOVERY PRINCIPLE Final Report
N. O. Brink Washington, NASA, Dec. 1965 101 p refs
(Contract NAS7-283)
(NASA-CR-351) CFSTI: HC $4.00/MF $0.75 CSCL 22A

This Final Report describes work on a program whose objective was to determine the feasibility of designing an expandable airlock utilizing elastic recovery materials. The airlock design criteria included requirements for easy crew transfer, micrometeoroid and thermal protection, maximal flexibility, multiple deployment–retraction cycles, and minimal leakage. The criteria resulted in an expandable airlock design approximately 4 ft in diameter and 7 ft long with a total system weight of 101 lb. The design of the expandable airlock was accomplished in accordance with all protective, structural, and operational requirements. The shape of the structural fabric was based on isotensoid characteristics. This design approach provides convolutions in the composite wall, which also improves packaging and folding characteristics. The operational requirements suggest the use of cables to retract the airlock for storage during periods when the structure is not in use; the system design defines a mechanism utilizing this means of retraction. Analysis has shown that the elastic recovery layers would provide the necessary protection against space hazards when the airlock was deployed. This study has indicated that an expandable airlock using elastic recovery materials is definitely feasible. Author

N66-13024*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A THEORETICAL AND EXPERIMENTAL STUDY OF THE NONLINEAR FLEXURAL VIBRATIONS OF THIN CIRCULAR RINGS
David A. Evensen Washington, NASA, Dec. 1965 61 p refs
(NASA-TR-R-227) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The nonlinear flexural vibrations of thin circular rings are analyzed by assuming two vibration modes and then applying Galerkin's procedure on the equations of motion. This procedure results in coupled nonlinear ordinary differential equations with time as the independent variable. The applied loading is taken to be harmonic in time, and approximate solutions to the equations are obtained by the method of averaging. One such solution involves the vibration of a single bending mode; a subsequent stability analysis shows that this single-mode response is valid only for certain combinations of amplitude and frequency. For example, when the driven mode exceeds a critical amplitude, nonlinear coupling causes its companion mode to respond and participate in the motion. Approximate solutions are obtained for this coupled-mode case, and their stability is examined. The steady-state response curves contain an unusual "gap" where both the one- and two-mode solutions are unstable. These results were confirmed on an analog computer, and nonsteady vibrations were observed in the gap region. Author

N66-13031# Joint Publications Research Service, Washington, D. C.

DETERMINATION OF PERIODIC FORCES AND MOMENTS ON A SCREW PROPELLER

I. Ya. Miniovich 2 Dec. 1965 9 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 4, Apr. 1962 p 10–12 (JPRS-33130; TT-65-33706) CFSTI: $1.00

Equations are presented for determining periodic forces and moments acting on a screw propeller blade. Since forces and moments cause the vibration of ship hulls and shafting, and lead to damage of the propeller shaft or its bearings, it is necessary to make a correct estimate of the peak and average values of all the components of the periodic forces and moments acting on the propellers. R.C.S.

N66-13045# Lockheed Missiles and Space Co., Sunnyvale, Calif.

AXISYMMETRIC VIBRATIONS OF A CYLINDRICAL SHELL OF NONLINEARLY ELASTIC MATERIAL

V. N. Patushikhin [1965] 3 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1965 p 131–132

Calculations are made of the axisymmetric vibrations of a nonlinear elastic cylindrical shell. R.N.A.

N66-13049*# National Aeronautics and Space Administration, Washington, D. C.

PROPAGATION OF AN ARBITRARILY ORIENTED RECTILINEAR CRACK DURING EXTENSION OF A PLATE [O RASPROSTRANENII PROIZVOL'NO ORIENTIROVANNOY PRYAMOLINEYNOY TRESHCHINY PRI RASTYAZHENII PLASTINY]

V. V. Panasyuk, L. T. Berezhnitskiy, and S. Ye. Kovchik Dec. 1965 13 p refs Transl. into ENGLISH from Prikl. Mekhan., Otd. Mat., Mekahn., i Kibernetiki, Akad. Nauk Ukr. SSR, v. 1, no. 2, 1965 p 48–55

(NASA-TT-F-402) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The effect of the orientation of a rectilinear crack, on its propagation during uniaxial extension of a plate is mathematically analyzed, assuming that the material of the isotropic plate obeys Hooke's law and the external force acts perpendicularly to the crack. The initial direction of propagation of the crack is always close to the direction normal to the line of action of the external force. A formula for calculating the magnitude of the external force at incipient propagation of the crack and the critical breaking stress is derived. At large angles made by the plane of the crack and the tangent to its initial propagation path, the crack propagated at stresses below unity. Author

N66-13074# Southwest Research Inst., San Antonio, Tex.

STUDIES OF THE FATIGUE STRENGTH OF PRESSURE VESSELS. I: CYCLIC PRESSURE TESTS OF LARGE SIZE PRESSURE VESSELS. 2: LOW CYCLE FATIGUE TESTING OF ONE-HALF SCALE MODEL PRESSURE VESSELS. 3. EFFECT OF WELD DEFECTS ON THE FATIGUE STRENGTH OF A302B STEEL Progress Report No. 15

A. G. Pickett, S. C. Grigory, and A. R. Whiting 18 Jul. 1965 20 p

(Contract AT(11-1)-1228)

(SWRI-1228-69; SWRI-1228-70; SWRI-1228-71)

A lead type failure occurred in nozzle 11 at the $\alpha = 0°$ location of the nozzle-to-shell intersection after 135 600 cycles of 0 to 2650 psig internal pressure. A photograph of this fatigue defect is shown. Ultrasonic inspections prior to the failure indicated that the fatigue defect initiated after about 100 000 cycles. Also, defects were noted at the $\alpha = 0°$ location of the nozzle-to-shell intersection of nozzle 2B during an ultrasonic inspection after 135 233 cycles. Out-of-roundness measurements on the nozzle S are also reported. Data are given for the results of weld defects in 1.5-inch by 3.0-inch specimens of A302B steel. E.E.B.

N66-13098*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

AN EVALUATION OF THE EFFECT OF FINITE SHEAR STRAIN IN A SHALLOW, SPHERICAL SHELL

Harry E. Williams 1 Oct. 1965 26 p refs

(Contract NAS7-100)

(NASA-CR-68395; JPL-TR-3Z-780) CFSTI: HC $2.00/MF $0.50 CSCL 20K

In an effort to assess the effect of including transverse shear strain in the analysis of thin shells, the equations proposed by E. Reissner are specialized for shallow, spherical shells and are solved for cases of loading for which the effect might be expected to be appreciable. It is found that, for materials that are nearly isotropic, the solution for an edge-loaded shell differs slightly from that of the classical equation. However, the solution in the neighborhood of a concentrated load applied at the apex is found to differ significantly from its classical counterpart. Author

N66-13129*# Aerojet-General Nucleonics, San Ramon, Calif.

METEOROID IMPACT SIMULATION BY MAGNETIC GRADIENT PARTICLE ACCELERATION TECHNIQUES Quarterly Progress Report, 1 Jul.–30 Sep. 1965

Robert L. Chapan [1965] 32 p refs

(Contract NAS8-11174)

(NASA-CR-68547; AN-1460) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A qualitative analysis was made of magnetic field diffusion into the projectile surface, and projectile heating. Non-linear calculations were performed. Included were computations using empirical functions of resistivity which account for the observed high field anomaly. The results indicate that flux diffusion and heating should not be a problem. The transfer of experimental work to the AGN Pulse Power Facility has been completed. There have been some delays caused by electronic failures and explosive procurement problems. A permanent detonator firing slave unit has been built which fires the 24 SE-1 detonator with an average deviation of ±0.01 μsec. Optical instrumentation has been developed for directly viewing the projectile during flux compression. Several tests have been conducted to check magnetic gradient accelerator (MGA) subsystem operation. All the basic components for the remainder of the experimental program have been fabricated. Several projectile experiments have been assembled and await delivery of explosives. Author

N66-13131# Bettis Atomic Power Lab., Pittsburgh, Pa.

CYGRO-STESS ANALYSIS OF THE GROWTH OF CONCENTRIC CYLINDERS

C. M. Friedrich Oct. 1965 36 p refs

(Contract AT(11-1)-GEN-14)

(WAPD-TM-514) CFSTI: $2.00

The digital computer program CYGRO determines stresses and strains in two concentric cylinders undergoing thermal strains and irradiation growth, where elastic, plastic, and creep parameters are given as functions of temperature and flux level. Volume growth, flux level, power level, gas pressure between cylinders, external pressure, and water temperature are given functions of time. At the beginning of each time step, the steady state temperature distribution is calculated and used to determine material properties. Author

N66-13156*# Westinghouse Electic Corp., Baltimore, Md. Defense and Space Center.

DETERMINATION OF FRACTURE TOUGHNESS PARAMETER OF LARGE METAL STRUCTURES Industrial Review

A. M. Wahl 10 Dec. 1964 13 p refs

(Contract NASw-952)

(NASA-CR-68469) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The fracture mechanics approach to predicting the fracture strength of large structures and machine components is discussed. In this approach, the elastic stress is calculated in the immediate neighborhood of a crack. The problem reduces to (1) calculating the stress intensity value for the actual structure under operating conditions; and (2) determining the plane strain fracture toughness value for the material by use of a suitable test specimen. The contributions of two NASA Technical Notes (TN) on this subject are assessed, and potential applications of the methods developed are discussed. It was concluded that one TN offers a practical method of calculating the fracture toughness parameter for a variety of test specimen shapes. The other TN provides a method for analyzing plastic strains in plate type structures, which appears valuable in developing the fracture mechanics approach to cases where considerable plastic flow occurs before fracture. M.G.J.

N66-13158*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

FORCED FLEXURAL MOTION OF A ROCKET-BOOSTED VEHICLE

Roger A. Anderson 3 Sep. 1962 22 p refs

(Contract NAS7-100)

(NASA-CR-68534; IPL-TM-33-147) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The equations for forced flexural motion are derived for a rocket-boosted vehicle controlled by vectored thrust. Planar motion is assumed. Motions involved in the system include flexural motion of the vehicle, fuel slosh, and rotation of the engine nozzle. The buckling effects of the tangential thrust component, and the longitudinal inertial and aerodynamic forces are ignored. The aerodynamic forces are derived from momentum theory. Forcing conditions which have been considered are those resulting from atmospheric motion, a sudden control change, or an initial disturbance. Author

N66-13173*# West Virginia Univ., Morgantown.

INVESTIGATION OF THE CONSTITUTIVE EQUATIONS FOR MULTI-PHASE HYPOELASTIC MATERIALS Final Report, Jun. 1, 1964-Sep. 1, 1965

R. D. Snyder [1965] 93 p refs

(Grant NsG-533)

(NASA-CR-68457) CFSTI: HC $3.00/MF $0.75 CSCL 20K

The investigation of the multi-phase problem for hypoelastic materials and, more generally, for linear preferred materials is initiated. Using classical elasticity as a guide, there is developed some variational, uniqueness, and minimum theorems analogous to those of classical elasticity. In addition, the possible existence of a deformation energy density function is investigated and discussed. Such a function is derived for two special forms of linear materials. Finally, the simple extensional deformation problem for such linear materials is investigated and discussed using two relatively simple materials as examples. Author

N66-13291*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF CHARACTERISTICS OF PRESSURE WAVES GENERATED IN WATER FILLED TANKS IMPACTED BY HIGH-VELOCITY PROJECTILES

Francis S. Stepka, C. Robert Morse, and Robert P. Dengler Washington, NASA, Dec. 1965 24 p refs

(NASA-TN-D-3143) CFSTI: HC $1.00/MF $0.50 CSCL 20K

A high-speed rifle and a light-gas gun were used to accelerate projectiles for impact into transparent water filled tanks over a range of velocities from 1.31 to 6.40 kilometers per second. The projectiles were solid spheres or cylinders of either copper, steel, nylon, aluminum, or tungsten carbide ranging in diameter from 1.59 to 5.56 millimeters. The wave front shape, the progress of the wave front as a function of time, and the intensity of liquid pressures induced as a result of the projectile impact were determined for the various impact conditions with a high-speed, continuous-writing, framing camera. Measurements and analytical predictions of the deceleration of the projectile in the liquid were also obtained to help relate the change of projectile kinetic energy to the charactersitics of the pressure wave generated. The projectile impacts, which resulted in a rapid transfer of energy to the liquid, produced essentially a point source energy release and resulted in an expanding, spherically shaped, pressure wave front that emanated from the point of impact. Extremely high pressures were generated in the liquid close to the point of impact, but these pressures decayed rapidly as the wave front propagated away from the point of impact. The progress of the wave front during the period of intense pressures was found to be proportional to time to about the 0.8 power. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-12152*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INTERFERENCE HEATING ON A SWEPT CYLINDER IN REGION OF INTERSECTION WITH A WEDGE AT MACH NUMBER 8

Dennis M. Bushnell Washington, NASA, Dec.1965 50 p refs

(NASA-TN-D-3094) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Local heat-transfer rates and pressures have been measured on a cylinder in the interference flow region between the cylinder and a 12° half-angle wedge. The tests were conducted at a Mach number of 8 with the cylinder at sweep angles of 45° and 60° with respect to the free stream. Results indicate that for both sweep angles, local heating is increased along the portion of the cylinder subjected to the wedge flow, but the maximum increase can be predicted for both laminar and turbulent boundary-layer flow by using local wedge flow conditions in the infinite swept cylinder theories. Because of the higher local Reynolds number in the wedge flow region, transition occurs along the cylinder stagnation line at a lower value of free-stream Reynolds number for the cylinder-wedge configuration than for the undisturbed cylinder; however, the local Reynolds number for transition based on conditions ahead of the cylinder bow shock and the cylinder diameter was virtually the same for all configurations tested. Author

N66-12188*# National Beryllia Corp., Haskell, N. J.

RESEARCH ON THERMAL TRANSFER PHENOMENA Third Quarterly Status Report, Jul. 1-Sep. 30, 1965

W. C. Allen [1965] 21 p ref
(Contract NASw-1197)
(NASA-CR-68094) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Magnesia-stabilized zirconia foams have been produced, which have a fired strength of 700 to 800 psi, an eightfold increase over the best strength previously obtained. As a result of this improvement, it has been possible to obtain thermal conductivity data to 2500° C (4532° F), a temperature approaching the melting point of this composition. The radiation component of heat transfer at temperatures above 3000° F seems to be almost as effectively minimized by scattering from the particle and pore surfaces themselves as by metallic or barrier phase additives. Program for the final quarter will include optimization of density and strength, further work on metallic reflectors, and improvements in precision of thermal conductivity data. Author

N66-12192*# Brown Engineering Co., Inc., Huntsville, Ala. Scientific Research Labs.
A METHOD FOR DIGITAL CALCULATION OF EQUILIBRIUM THERMODYNAMIC PROPERTIES OF AIR
V. L. Reed Jul. 1963 43 p refs
(Contract NAS8-2485)
(NASA-CR-68123; R-58) CFSTI: HC $2.00/MF $0.50 CSCL 20M

The thermodynamic properties of air at equilibrium are obtained using the principles of classical (Boltzmann) statistical mechanics, the laws of mass action and the values of the spectroscopic and molecular data available. The accuracy of the method is within a few percent of the more rigorous methods of Chapman and Enskog, i.e., the neglect of intermolecular potentials and the utilization of a hard sphere gas model are the principle differences. It should be established that, although these seem to be quite restrictive, the data obtainable from the following method is accurate to within only a few percent and may be utilized to a great advantage in routines and procedures in connection with high speed digital computational programs. Author

N66-12252*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF THERMOPHYSICAL PROPERTIES OF POTASSIUM
Harold H. Coe Washington, NASA, Dec. 1965 40 p refs
(NASA-TN-D-3120) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Recently reported thermodynamic and physical property data on the alkali metal potassium are compiled and the results of the various sources are compared with previously existing data. Data for the liquid properties of specific heat, thermal conductivity, enthalpy, entropy, voscosity, electrical resistivity, density, and surface tension are presented over the temperature range from 200° to 2200° F when possible. Data for the saturated vapor properties of specific heat, thermal conductivity, vapor pressure, heat of vaporization, entropy of vaporization, viscosity, and density are presented over the temperature range from 800° to 2200° F. The results from the several sources agree very well for most of the properties in the lower temperature range up to about 1400° F. However, significant differences are apparent for some of the properties at temperatures above 1400° F. Author

N66-12253*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CREEPING FLOW SOLUTION OF THE LEIDENFROST PHENOMENON
Kenneth J. Baumeister and Thomas D. Hamill Washington, NASA, Dec. 1965 27 p refs
(NASA-TN-D-3133) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Mass evaporation rates and heat transfer coefficients are determined theoretically for liquid drops supported over a flat hot plate by their own superheated vapor. It is assumed that the liquid drops have a flat disk geometry with a uniform vapor gap beneath and a saturated vapor cover, that the bottom of the drop is at saturation temperature, and that evaporation takes place uniformly beneath the drop. A heat transfer coefficient is obtained for steady-state laminar incompressible flow, assuming constant properties, by similtaneous solutions for the Navier-Stokes, continuity, and energy equations. Equations are developed for heat transfer to the drop and from the plate. Results agree with values previously obtained by computer solution of Navier-Stokes equations. It is concluded that inertia terms are negligible relative to viscous terms in the Navier-Stokes equation. Basic models and equations and method of solution are detailed. M.W.R.

N66-12254*# Case Inst. of Tech., Cleveland, Ohio.
THE RADIAL HEAT EQUATION AND LAPLACE TRANSFORMS
Louis R. Bragg Washington, NASA, Dec. 1965 12 p refs
(Grant NsG-544)
(NASA-CR-337) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Integral representations involving Laplace transforms and their inverses are developed. The importance of the representations, which are alternate to other forms of representation, lie in the fact that the elements of distribution theory can be more readily fitted into the study of solutions and properties of solutions of the radial heat equation:

$$\frac{\partial}{\partial t}u(r,t) = \Delta_{\mu}u(r,t)$$

and that the extensive literature and tables relating to Laplace transforms can be brought to bear on the solutions of the radial heat equation. The term μ is considered to be a real parameter, and Δ_{μ} denotes the radial Laplacian operator $D_r^2 + \frac{\mu - 1}{r} D_r$.

L.S.

N66-12274# Los Alamos Scientific Lab., N. Mex.
THERMODYNAMIC-TRANSPORT AND RELATED PROPERTIES OF PARA-HYDROGEN FROM 36 TO 5000°R AT PRESSURES TO 5000 psia
Otis A. Farmer 29 Oct. 1965 35 p refs
(Contract W-7405-ENG-36)
(LA-3405-MS) CFSTI: $2.00

Tables and graphs of thermodynamic-transport and related properties of para hydrogen are provided from the best available source data for the temperature range from 36 to 5000° R. Author

N66-12381*# Naval Research Lab., Washington, D. C.
HIGH-TEMPERATURE PROPERTIES OF CESIUM
C. T. Ewing, J. P. Stone, J. R. Spann, E. W. Steinkuller, D. D. Williams et al 24 Sep. 1965 51 p refs
(NASA Order C-76320)
(NASA-CR-68381; NRL-6246; AD-622227) CFSTI: HC $3.00/MF $0.50 CSCL 20M

This report derives the skin effect equations for current-carrying cylindrical conductors and semi-infinite sheets taking into account weak magnetic hysteresis effects. Numerical solutions to the nonlinear equations are obtained for annealed iron conductors as a function of frequency and magnetic field intensity; results are compared with analytical solutions obtained if hysteresis effects are neglected. With hysteresis present the

ratio of a-c reactance to d-c resistance decreases significantly whereas the ratio of a-c resistance to d-c resistance shows little change. Author (TAB)

N66-12441*# National Bureau of Standards, Boulder, Colo.
BOILING HEAT TRANSFER FOR OXYGEN, NITROGEN, HYDROGEN, AND HELIUM
E. G. Brentari, P. J. Giarratano, and R. V. Smith 20 Sep. 1965 124 p refs
(NASA Order R-45)
(NASA-CR-68614; NBS-TN-317) CFSTI: HC $4.00/MF $1.00 CSCL 20M

This study has been conducted to provide an orderly examination of the information relative to boiling heat transfer for four cryogenic fluids. The general approach has been to examine experimental data with respect to the predictive correlations which would appear to have probable success and which would be likely to be used by design engineers. These correlations were graphically and statistically compared. The results are discussed, and when it appears a best or acceptable recommendation can be made, computation aids for designers are included. These aids are in the form of graphical presentations for preliminary studies and equations for computer studies. The authors have also indicated the apparent limits for the use of these correlations, when possible. The effect of many variables which would often be significant are not included in the predictive correlations. The influence of these variables is discussed in a separate section on boiling variables. Author

N66-12497# Argonne National Lab., Ill.
A LIQUID-METAL HEAT-TRANSFER EXPERIMENT
R. E. Holtz Jun. 1965 34 p refs
(Contract W-31-109-ENG-38)
(ANL-7038) CFSTI: $2.00

The utility of thermal-radiation heat transfer as a means of supplying and removing heat from a flowing liquid metal was experimentlly investigated and found to be a satisfactory technique for this application. Single-phase heat transfer to liquid NaK during vertical upflow in a tube was also examined. These experimental results are in fair agreement with the semiempirical expressions of R. N. Lyon and O. E. Dwyer. The effect of the initiation of nucleate boiling in the system are also observed. Author

N66-12512# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT TRANSFER OF A TURBINE ROTOR WITH RADIAL FLOW OF COOLING MEDIUM
V. M. Kapinos 9 Aug. 1965 16 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), no. 1, 1964 p 3–11
(FTD-TT-65-957/1+2; AD-620862)

Heat exchange of a rotor with arbitrary distribution of temperature along the radius is studied. Criterional formulas for determining the coefficients of heat exchange at end surfaces of disc or drum rotors are proposed which are based on an approximate theoretical solution of the problem considered and of experimental data. Author (TAB)

N66-12534# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SYSTEM FOR THE PROTECTION OF GAS TURBINE VANES AND DISC FROM ABRUPT COOLING DURING A SUDDEN SHUTDOWN
M. M. Kovalevskiy, N. G. Ul'yanov, and V. A. Babich 15 Sep. 1965 5 p Transl. into ENGLISH from Soviet patent no. 164510, (Appl. no. 829609/24-6, 8 Apr. 1963) 1 p
(FTD-TT-65-502/1+2+4; AD-621782)

The system for the protection of the vanes and disc of a gas turbine from abrupt cooling during a sudden shutdown, containing a throttle for air-flow blockage, is distinguished by the fact, that, for the purpose of improving the protection of the turbine vanes and disc from abrupt cooling by providing a gradual flame-out, the system is equipped with an air-throttle-interacting and preclosure-operating system of partial (up to 25% of basic) fuel supply into the combustion chamber after closure of the check valve, and is accomplished in the form of a bypass line with an automatic valve which is gradually closed by means of a servomotor. Author (TAB)

N66-12621# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISTRIBUTION OF DROPS ACCORDING TO SIZE IN ATOMIZING LIQUIDS BY MEANS OF CENTRIFUGAL ATOMIZERS
L. G. Golovkov 3 Jun. 1965 14 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 11, 1964 p 55–61
(FTD-TT-65-176/1+2; AD-620948)

The article presents further support of the function of distribution of drops according to size proposed in a work by Tresh, explains the method of parameter derivation for this function and establishes the numerical value of its parameters for centrifugal atomizers. Author (TAB)

N66-12651# Joint Publications Research Service, Washington, D. C.
COMBUSTION AND EXPLOSION
1 Dec. 1965 55 p refs Transl. into ENGLISH from Nauchno-Tekhn. Probl. Goreniya i Vzryva (Novosobirsk), no. 2, 1965 p 35–42, 56–61, 69–75, 93–100
(JPRS-33116; TT-65-33693) CFSTI: $3.00

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6. SIXTH SESSION OF THE ACADEMIC COUNCIL ON NATIONAL-ECONOMIC USE OF EXPLOSION p 49–52

N66-12652 Joint Publications Research Service, Washington, D. C.
STRUCTURE OF A MULTIFRONT-LINE DETONATION WAVE IN A GAS
R. I. Soloukhin *In its* Combust. and Explosion 1 Dec. 1965 p 1–12 refs (See N66-12651 03-33) CFSTI: $3.00

Results of overall investigations of multifront-line waves of detonation in a gas by registration of pressure, density, temperature and glow in the front, with resolution in time of less than 0.5 microsecond (near 1 mm), are described. From these experiments it was noted that the process of gas combustion behind the shock front of detonation remains essentially irregular, and the zone of chemical transformation was wider than the expected one-dimensional zone of reaction, due to the hydrodynamic effects. Other areas of interest discussed include gas pressure and glow, gas density profile, temperature measurement, and kinetic data comparison. R.W.H.

N66-12653 Joint Publications Research Service, Washington, D. C.

THE EFFECTS OF EXPLOSION ON MATTER THERMODYNAMICS OF SHOCK COMPRESSION OF POWDERS

S. S. Batsanov, A. A. Deribas, and S. A. Kutolin *In its* Combust. and Explosion 1 Dec. 1965 p 13–24 refs (See N66-12651 03-33) CFSTI: $3.00

A metallic cylindrical ampule in the first approximation of an ideal incompressible liquid is among the data considered. The case of ampule compression by an external VV charge immediately adjacent to the ampule walls and located concentrically, with the ampule and VV charge in a vacuum, was also investigated. For the determination of temperature and energy, a series of calorimetric experiments was conducted; at a fixed time after the moment of the explosion the ampule was placed in a water calorimeter and the increase in the water temperature was determined. Results are given of these temperature measurement increases, and also the extrapolation at zero moment of time. R.W.H.

N66-12654 Joint Publications Research Service, Washington, D. C.

NON-STATIONARY COMBUSTION OF POWDER UNDER THE ACTION OF A PRESSURE IMPULSE

Yu. A. Gosmintsev and A. D. Margolin *In its* Combust. and Explosion 1 Dec. 1965 p 25–32 refs (See N66-12651 03-33) CFSTI: $3.00

Nonstationary powder combustion during superposition of a pressure disturbance in the form of a step and a triangular impulse was considered. For solution of the nonlinear heat conduction equation, the method of integral relationships was used. The obtained region of powder extinguishment is dependent upon the intensity and impulse width of the pressure. Also considered was the powder combustion in a semi-infinite region. It was noted that the burning surface was motionless and was disposed in the origin of the coordinates. During a constant pressure and combustion rate a certain stationary distribution of temperature was established in the powder. R.W.H.

N66-12655 Joint Publications Research Service, Washington, D. C.

ANALOGY OF DETONATION OF GASEOUS AND LIQUID EXPLOSIVES

A. N. Dremin and O. K. Rozanov *In its* Combust. and Explosion 1 Dec. 1965 p 33–42 refs (See N66-12651 03-33) CFSTI: $3.00

Identical behavior of the detonation wave in gases and in liquid VV was observed at transition from a cylindrical tube into an expanded cone. These experiments showed that the value of angle α depended on the diameter of the cylindrical tube and increased with an increase in the latter. In gas detonation a change of heterogeneities dimension was observed in wider limits than in liquid VV. During propagation of the detonation wave a single crystal was loaded so fast that defects were not detected. This occurred because the defects were able to shift in a crystal with velocities known to be less than the speed of sound, when the velocity of the load was supersonic. R.W.H.

N66-12722 Joint Publications Research Service, Washington, D. C.

A CALORIMETER FOR INVESTIGATING HEAT TRANSFER BETWEEN THE ENDS OF A CYLINDRICAL GAS SPACE

V. A. Potroshkov *In its* Izv. VUZov: Instr. Bldg., Vol.8, No. 4, 1965 25 Nov. 1965 p 136–140 refs (See N66-12701 03-14) CFSTI: $5.00

In this article we consider the design and operating principle of a calorimeter for studying heat transfer through a closed air space, and also an automatic power regulation (control) circuit for a protective heater. Author

N66-12753 Joint Publications Research Service, Washington, D. C.

THE FIRST NATIONAL MEETING OF ENGINEERING THERMAL PHYSICS

Chung-Hua Wu *In its* Transl. on Communist China's Sci. and Technol., No. 244 23 Nov. 1965 p 17–24 Transl. into ENGLISH from R'o Hsueh T'ung Pao (Peking), no. 10, Oct. 1965 p 933–935 (See N66-12751 03-34) CFSTI: $3.00

Papers delivered at Communist China's first national meeting on engineering thermal physics dealt with five general fields: (1) engineering and gas thermodynamics, (2) heat transmission and atomic energy machines, (3) heat and gas jet engines, (4) combustion physics and the internal combustion engine, and (5) thermal measurement and theory. Abstracts are given of some of the articles presented at the Peiping meeting. M.W.R.

N66-12826# California Univ., Berkeley. Inst. of Engineering Research.

EXPERIMENTAL STUDY OF WAVE PHENOMENA ASSOCIATED WITH THE ONSET OF GASEOUS DETONATION

P. A. Urtiew Feb. 1965 128 p refs
(Grant AF-AFOSR-129-64)
(AS-65-1; AFOSR-65-1277; AD-621214)

The study is concerned with wave processes that occur at the instant of transition from the deflagrative to the detonative mode of propagation of the combustion wave in an explosive gas mixture. Experimental observations were made by means of Schlieren photography with pressure transducer measurements using stoichiometric hydrogen–oxygen mixtures contained initially, under normal pressure and temperature, in a 1 X 1-1/2 inch rectangular, cross-section tube. Theoretical interpretation of experimental results revealed that the transition is promoted by the action of a spherical detonation wave generated by a point explosion ahead of the main combustion zone. Upon reflection from the walls this gives rise to a sound wave system oscillating transversely to the axis of the tube and bounded in the direction of the axis, on one side, by the detonation front propagating into the unburned medium and, on the other, by the retonation shock moving into the burned gas. Author (TAB)

N66-12833# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN ERROR ANALYSIS OF NUMERICAL SOLUTIONS OF THE TRANSIENT HEAT CONDUCTION EQUATION

Donald B. Mitchell (M.S. Thesis) Aug. 1965 110 p refs
(GA/PH/65-10; AD-621274)

In this investigation the transient temperatures in a semi-infinite slab with a convective boundary layer are determined numerically using the Crank–Nicolson and Crandall Methods. These temperatures are compared with the exact solution to determine if the Crandall technique, as theoretically predicted, has smaller truncation error. A finite difference boundary equation is derived for the convective boundary condition which is consistent with the internal node formula developed by Crandall. The latter formula and the derived boundary equation are used to obtain six node temperatures at six time intervals for values of M (inverse Fourier modulus) equal to 1, 2, 3, 4, and the square root of 20; and N (Nusselt modulus) equal to 2, 1/2, 1/4, and 1/8. The results show that these temperatures are always more accurate than those obtained using the Crank–Nicolson Method if the nodes are closely spaced (N equal to 1/8). In addition, the solutions for those values of M and N which permit the boundary equation truncation error to be minimized indicate that the Crandall Method is more accurate if N is $\leq 1/2$. The accuracy improvement factors for the two numerical methods are also determined; however, the results do not agree with those predicted theoretically and show no consistent trends. Also, the equation required to apply the Crandall technique to bodies with variable thermal properties is derived. Author (TAB)

N66-12855*# General Applied Science Labs., Inc., Westbury, N. Y.

INVESTIGATION OF CUMBUSTION OF HYDROGEN IN A HYPERSONIC AIR-STREAM Final Report

S. Slutsky Mar. 1965 70 p refs

(Contract NAS8-2686)

(NASA-CR-68191; GASL-TR-529) CFSTI: HC $3.00/MF $0.75 CSCL 21B

A detailed investigation of the problem associated with the venting of combustible hydrogen from launch vehicles is summarized. Problems associated with the kinetics of the hydrogen air system, including the two phase phenomena associated with cryogenic hydrogen, as well as the fluid mechanical mixing problems and the coupling of the two were considered. Experiments were performed in support of the many theoretical analyses.It is concluded that the manner of hydrogen venting determines the combustion hazard. Results indicate combustion would occur if the venting were such that hydrogen could diffuse into the boundary layer on the vehicle surface. In reaching these conclusions important technical capabilities in the fields of two phase flow, detailed compressible turbulent boundary layer studies, and practical techniques for computing flows with diffusion and finite rate chemistry were developed. Author

N66-12866# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Div.

HEAT TRANSFER DOMAINS FOR FLUIDS IN A VARIABLE GRAVITY FIELD WITH SOME APPLICATIONS TO STORAGE OF CRYOGENS IN SPACE

M. Adelberg and S. H. Schwartz [1965] 36 p refs Presented at Cryog. Eng. Conf., Houston, Tex., 23–25 Aug. 1965 (Douglas Paper-3516)

To facilitate analyses of a number of problems peculiar to heat transfer analyses of cryogenic fluids in a reduced gravitational field, the domains of applicability of a number of heat transfer relations are presented. Most of the critical values of the important parameters are available in the literature and these are summarized. In some cases the need for new criteria is recognized and these are developed. Included in this category of new domain limits are: the lower limit of the Rayleigh number for laminar-free convection and the critical times for transition from conduction to convection for flat plates in various positions and for both laminar and turbulent flow. Special figures are generated attempting to graphically illustrate the location of the various domains. In most figures, the type of fluid must be assumed and for these cases both hydrogen and oxygen are considered. Numerical examples for the cases of hydrogen and oxygen under reduced gravity levels are also presented. Author

N66-12888# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

INVESTIGATION OF THE MIXING OF COAXIAL HETEROGENEOUS GAS JETS AS APPLIED TO SUPERSONIC COMBUSTION

Gilles L. Hamelin (Ph.D. Thesis) Aug. 1965 77 p refs

(GA/ME/65-2; AD-622035)

An experimental investigation of the turbulent mixing of a sonic jet of helium discharging coaxially into a supersonic jet of air was made using a two dimensional mixing chamber. Volumetric concentration profiles were obtained and mass concentration and velocity along the jet centerline were plotted. The results indicated that both these vary inversely with the distance from the mixing origin raised to a four third power. Schlieren photography was applied in a semi-quantitative manner to confirm the validity of the above findings. This research project finds a potential application in the study and analysis of supersonic combustion ramjet engines.

Author (TAB)

N66-12911# Oak Ridge National Lab., Tenn.

TEMPERATURE DEPENDENCE OF THE DIFFUSION COEFFICIENT OF GASES

V. F. Vyshenskaya and N. D. Kosov 9 Apr. 1965 13 p refs Transl. into ENGLISH of a Paper Presented at the Heat and Mass Transfer, 1st all Union Conf., Minsk, 1961 (ORNL-TR-506)

Two methods (weight and freezing) for determining the diffusion coefficients of gases are described. The first method was used to determine the diffusion coefficients of the gaseous systems I_2–CO_2, CO_2–H_2, CO_2–N_2, H_2–N_2, and I_2–N_2. A semi-empirical formula for the temperature dependence is proposed, and a relationship is established between the self-diffusion coefficients and the mutual diffusion of gases. The proposed formula and the Chapman-Enskog formula both are in satisfactory agreement with the experimental data. NSA

N66-13008*# North Dakota Univ., Grand Forks. Engineering Experiment Station

TIME-TEMPERATURE CHARACTERISTICS OF THIN-SKINNED MODELS AS AFFECTED BY THERMOCOUPLE VARIABLES First Semiannual Report

Milton B. Larson Oct. 1965 9 p

(Grant NGR-35-002-003)

(NASA-CR-68315) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Definitions are given and equations are presented for time-temperature characteristics of thin-skinned models as affected by thermocouple variables. It is shown that no resolution to the problem was reached, and that some numerical integration may provide a satisfactory solution. R.R.D.

N66-13019*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TWO-DIMENSIONAL HEAT TRANSFER IN RADIATING STAINLESS-STEEL-CLAD COPPER FINS

Norbert O. Stockman and Edward C. Bittner Washington, NASA, Dec. 1965 26 p refs
(NASA-TN-D-3102) CFSTI: HC $1.00/MF $0.50 CSCL 20M

An analysis of the two-dimensional heat transfer in a radiating composite fin is presented together with details of the numerical method of solution. Several stainless-steel-clad copper fins typical of finned-tube space radiators are analyzed over a range (0 to 1) of stainless-steel to copper thickness ratio. Items discussed are temperature profiles along the fin length, temperature drop across fin thickness, effective conductivity, fin efficiency, heat rejection rate per unit weight, and ratio of effective conductivity to effective density. It was found for the particular geometries analyzed that the two-dimensional temperature distribution in the fin cross section is essentially one-dimensional. The use of the thickness-averaged conductivity in one-dimensional calculations yields essentially the same results as the two-dimensional calculations. Author

N66-13041# Los Alamos Scientific Lab., N. Mex.
FURTHER EXPERIMENTAL STUDY OF H_2O–LH_2 HEAT EXCHANGERS
J. R. Bartlit and K. D. Williamson, Jr. [1965] 21 p refs
(Contract W-7405-ENG-26)
(LA-DC-7148; CONF-650802-6)

The results reported are an extension of a study of heat transfer and ice formation during the steady-state operation of countercurrent H_2O–LH_2 heat exchangers which was reported at the 1964 Cryogenic Engineering Conference. The results from both exchangers indicated that where the swirl inducer was present, heat transfer coefficients approached the values predicted by the Dittus-Boelter equation over the temperature range from 50–500° R. These data are in contrast to previously reported coefficients from the model without a swirl inducer. Under these conditions coefficients as low as 11% of Dittus-Boelter were found at low temperatures. Ice thicknesses in both exchangers were calculated to be less than 0.1 inch. The effluent from the full-scale unit was used to drive the turbine of a liquid hydrogen pump. This system was operated without troublesome pressure oscillations. Author

N66-13083*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AEROTHERMOCHEMICAL ANALYSIS OF NON-OSCILLATORY AND OSCILLATORY CHARACTERISTICS OF LIQUID BIPROPELLANT ROCKET MOTORS: WAVE MODEL, DROPLET HEATING, AND EVAPORATION PROGRAM COMPUTATION Third Quarterly Report No. 65-1
Vito D. Agosta and S. Z. Burstein 15 Jan. 1965 18 p
(Contract NAS7-100)
(NASA-CR-68546) CFSTI: HC $1.00/MF $0.50 CSCL 20I

This report is divided into three parts: (1) a description of the wave propagation model, (2) fuel droplet heating analysis, and (3) discussion of work on the non-oscillatory aerothermochemical computer program. It is decided to use a wave propagation model in which the wave lengths are coupled to the cavity dimensions. From the droplet heating analysis, it is found that very large temperature gradients exist near the surface, the interior of the droplet remaining relatively unheated. In addition, heat-up time to saturation conditions for a (0.375×10^{-3} ft) drop is about 40 microseconds. The computer program is the modification of an earlier code that was designed to test some basic ideas on the theory of evaporation rate controlled combustion. It is designed to solve automatically and simultaneously the interaction between the nonlinear gas dynamic equations and the two components of the spray, i.e., fuel and oxidizer. In addition, the effect of equilibrium dissociating combustion products on this solution is included. Author

N66-13085*# Bureau of Mines, Pittsburgh, Pa.
HYDROGEN SAFETY Progress Report No. 6, 1 Apr.–30 Jun. 1965
R. A. Van Meter, A. Strasser, E. L. Litchfield, and J. Grumer Jul. 1965 27 p refs Prepared for NASA
(NASA-CR-68453) CFSTI: HC $2.00/MF $0.50 CSCL 21B

The theories of jets and plumes are applied to hydrogen plumes to establish the reliability of these theories to practical application by means of relatively small scale modeling experiments with emphasis on the meteorological and air pollution aspects of the problem. Plume theory contains much that is applicable to the problems involved with the diffusion of hydrogen released into either the open atmosphere or into the confines of a reasonably large room. For setting up quantity-distance criteria and guidelines for the optimum placement of hydrogen detectors, one of the requirements will be an ability to predict hydrogen concentrations based on known parameters. As an example of such prediction, new numerical solutions to the non-dimensional equation for a steady plume in a constant density environment were calculated. Four hydrogen gas detector units were subjected to a series of tests which were designed to evaluate them under likely operation conditions. Graphs showing response times are included. M.R.W.

N66-13099*# United Aircraft Corp., East Hartford, Conn. Research Labs.
THERMODYNAMIC PROPERTIES OF COOLANT FLUIDS AND PARTICLE SEEDS FOR GASEOUS NUCLEAR ROCKETS
R. Roback Sep. 1964 25 p refs
(Contract NASw-847)
(NASA-CR-68392; C-910092-3) CFSTI: HC $1.00/MF $0.50 CSCL 18J

Thermodynamic properties and equilibrium chemical composition were calculated for various materials which could serve as moderator coolants or as particle seeds designed to control radiant heat transfer in gaseous nuclear rocket engines. The materials which were considered as moderator coolants were hydrogen, methane, water, ammonia, deuterim, heavy water, and helium. Materials which were considered as possible particle seeds were several elemental species which have high boiling points, such as graphite, tungsten, and molybdenum, and the oxides, carbides, nitrides, and borides of titanium and zirconium. The results of the calculations indicate that the use of graphite as a seed material is impractical because graphite reacts readily with hydrogen, and consequently, excessive quantities of graphite must be added to the hydrogen stream in order to maintain even very small concentrations of seed particles at high temperatures. Also, the limited thermodynamic data currently available indicate that no significant increase in particle vaporization temperature would result from using oxides, carbides, nitrides, or borides of such high-melting-point metals as titanium and zirconium as seeds in place of the metals themselves. Author

N66-13132# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
BIOSATELLITE: THREE DAY VEHICLE THERMAL BALANCE TEST Pre-Test Report
R. L. Bender 25 Jun. 1965 47 p refs
(DOC.-65SD728)

Thermostatically controlled heaters and passive insulation and coatings will be used to control the thermal balance of the vehicle. The capsule temperature will be maintained by low flux heaters bonded to the capsule walls and controlled by a proportional voltage controller backed up by high and low limit thermostats. Also, insulation will be applied to the exterior of the capsule to minimize heat losses due to radiation. The external surface area of the adapter will be insulated with super insulation. A coating will be applied to the outside layer of the super insulation and to the exposed areas of the adapter to establish the necessary emissivities of these surfaces. Thus, the net heat radiated to or from these surfaces will be passively controlled. This engineering development test will be performed to evaluate the adequacy of the passive thermal design of the capsule and the adapter. The test will consist of subjecting a complete structural vehicle to thermal-vacuum environments which will simulate various anticipated orbit conditions. Author

N66-13160*# Brown Univ., Providence, R. I.
USE OF A TRANSCENDENTAL APPROXIMATION IN TRANSIENT CONDUCTION ANALYSIS
P. D. Richardson and W. W. Smith (Taco, Inc.) Jul. 1965 23 p refs
(Grant NGR-40-002-012)
(NASA-CR-68536) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Biot's variational method is applied to a problem of transient heat conduction in a semi-infinite slab subject to a nonlinear boundary condition. A two-parameter transcendental approximation is used for the temperature profile, so that the profile determined for each case considered can have the shape most appropriate to it. Computations for asymptotic short-time and long-time solutions utilizing the general exponential integral are described, and two exact solutions are mentioned for cases which bound the examples computed. Comparison of the variational solution using the transcendental approximation with the exact solution for the limiting case of constant heat flux demonstrates an error of less than 0.2 percent in the surface temperature coefficient and very close representation of the true temperature profile. Comparison of the variational solution for other examples shows that the computed profile shapes have a uniform variation which is in the correct direction to merge with the limiting case of surface heat flux directly proportional to surface temperature. Author

N66-13170*# California Univ., Berkeley. Inst. of Engineering Research.
INFRARED RADIATION OF CARBON MONOXIDE AT HIGH TEMPERATURES
M. M. Abu-Romia 30 Sep. 1965 57 p refs
(Contract NAS8-11468)
(NASA-CR-68504; TS-65-5) CFSTI: HC $3.00/MF $0.50 CSCL 20M

The dependence of the infrared absorption spectrum of carbon monoxide on the geometric path length, pressure, and temperature was investigated experimentally. The gas samples were heated in a high-temperature furnace which consists of a graphite resistance heater with an inner ceramic tube for containment of the testing gas. Ceramic and stainless steel holders with sapphire windows at the inner ends were used to confine the path length. Spectral absorption measurements for the 4.67 micron fundamental band were performed for path lengths of 1, 5, 10 and 20 cm at temperatures of 300°, 600°, 900°, 1200° and 1500° K in the pressure range 1/4 to 3 atm. For the fundamental band, the spectral absorption data for the 10 and 20 cm path lengths were correlated by the Elsasser strong line approximation for all temperatures. The integrated absorption for both the fundamental and first overtone bands is given in tabular form as a function of temperature, pressure and path length. A method of correlating the integrated band absorption is indicated, and the results for 900° K are shown. An example of using the integrated band absorption results in calculating the emissivity of carbon monoxide is demonstrated. Author

N66-13230*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AN ANALYSIS OF A CHARRING ABLATION THERMAL PROTECTION SYSTEM
Donald M. Curry Washington, NASA, Dec. 1965 110 p refs
(NASA-TN-D-3150) CFSTI: HC $4.00/MF $0.75 CSCL 20M

An analytical model is presented for predicting the transient one-dimensional thermal performance of a charring-ablator heat-protection system when exposed to a hyperthermal environment. The heat-protection system is considered to consist of an ablation material and backup structure. The ablating material is further considered to consist of three distinct regions or zones: char, reacting, and virgin material. A FORTRAN IV digital computer program (STAB II) utilizing an implicit finite difference formulation has been written for the IBM 7094/40 computer system. The program considers one ablating material and a maximum of 12 backup materials with conduction or radiation and/or convection allowed between materials. Thermal properties of all materials are temperature dependent, with the properties of the charring material also being state dependent. The governing differential equations and their implicit finite difference formulation are presented. The program input and output are described in detail. The FORTRAN program statements and nomenclature are presented. Also, the theoretical and experimental results are compared. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-12174*# Florida Univ., Gainesville. Bureau of Economic and Business Research.
ANALYSIS OF RETAIL TRADE IN THE CAPE KENNEDY AREA
Ralph H. Blodgett 10 May 1965 34 p
(Grant NsG-507)
(NASA-CR-68282) CFSTI: HC $2.00/MF $0.50 CSCL 05C

An economic analysis was made of retail trade in the seven counties of the Cape Kennedy area. In connection with total retail sales, numbers of retail establishments, and members of paid employees, the area had a smaller share of state totals in 1954 than in 1939. From 1954 to 1963, under the influence of the NASA program, the region gained more rapidly than the state in all aspects of retail trade. Five counties increased their total retail sales faster than the state, four counties increased their numbers of retail establishments faster than the state, and six increased their numbers of paid employees in retailing more rapidly than the state during this period. Brevard County was the leader in all respects. From 1954 to 1963 it had an average annual rate of increase of 51.75% in total retail sales, 42.10% in numbers of paid retail employees, and 14.64% in

numbers of retail establishments. Most of the other counties have also had annual rates of increase which were higher than those for the state as a whole in the various phases of retailing. R.N.A.

N66-12194*# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.
SOURCES OF IDEAS AND THEIR EFFECTIVENESS IN PARALLEL R & D PROJECTS
Thomas J. Allen Jul. 1965 26 p refs Presented at the 2d ONR Conf. on Res. Program Effectiveness, Washington, D. C., 28 Jul. 1965 *Its* Working Paper No. 130-65
(Grants NsG-235-62; NSF GN-233; NSF GN-353)
(NASA-CR-68156) CFSTI: HC $2.00/MF $0.50 CSCL 05B

Seven sets of parallel R & D projects involving 15 laboratories are examined. Data gathered by Solution Development Records—a form which provides a weekly estimate of the probability of adoption of the approaches under consideration as possible solutions to a technical problem—and post-project interviews with the engineers responsible for each problem. The sources of technical approaches, indicated on the Solution Development Records, were obtained during the post-project interviews. Eight possible sources of ideas are considered. Better performing groups are found to rely more than poorer performers upon information sources within the laboratory, for generation of ideas. A serious misalignment appears to exist between the quality of ideas generated through the eight channels and the frequency with which these channels are used by engineers. Vendors and analysis and experimentation, by the engineer himself, appear to be over-utilized relative to their effectiveness as idea sources, while information available from other company research programs and from the lab's technical staff is under-utilized. Author

N66-12367# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 234
8 Nov. 1965 94 p refs Transl. into ENGLISH from K'o-Hsueh T'ung Pao (Peking), no. 6, 1965 p 511–538, 551–556
(JPRS-32764; TT-65-33342) CFSTI: $3.00

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N66-12401*# National Aeronautics and Space Administration, Washington, D. C.
NASA UNIVERSITY PROGRAM REVIEW CONFERENCE
1965 375 p refs Conf. held Kansas City, Mo., 1–3 Mar. 1965 (NASA-SP-85) GPO: HC $1.50; CFSTI: MF $2.00 CSCL 05I

Conference papers are presented which review the purpose, opportunities, training, research, space flight experiments, technology utilization, and research facilities of the NASA university program. For individual titles see N66-12402–N66-12428.

N66-12402* National Aeronautics and Space Administration, Washington, D. C.
THE NATURE AND SCOPE OF THE NASA UNIVERSITY PROGRAM
T. L. K. Smull *In its* NASA Univ. Program Rev. Conf. 1965 26 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The manner in which the NASA program was developed is reviewed and the organization of NASA is presented. The nature and scope of university activities in this program are outlined and the NASA FY 1964 obligations to the universities in the program are given. Research support, satellite instrumentation, tracking and data acquisition, research facilities, training in space science and technology, career employee training, and Apollo guidance are discussed. Also, the distribution of NASA trainees in the physical sciences, engineering, life sciences, and behavioral sciences are given. In 1965, there will be 3132 students studying for doctoral degrees under this program. Further, the NASA has made 27 research facilities grants to nonprofit scientific and educational institutions for the construction of urgently needed facilities. The grants that have been made as of March 1, 1965, from the inception of this program in fiscal year 1962, are shown. The geographical location of these research facilities are also shown. E.E.B.

N66-12403* National Aeronautics and Space Administration, Washington, D. C.
THE NASA SPACE SCIENCE AND APPLICATIONS PROGRAM
Homer E. Newell *In its* NASA Univ. Program Rev. Conf. 1965 9 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The NASA program includes basic science, the advancement of technology, the application of space knowledge and technology to practical uses, and the development of manned space flight. The space science and applications program is reviewed. Fifty-four successful satellite and space probe flights have been achieved in this program. In addition, hundreds of successful sounding rocket flights, balloon borne and aircraft experiments, ground observations, laboratory research, and theoretical work serve to round out the effort, and to establish close ties between the space flight program and related ground-based activities. The space science program was designed to enable the scientific community, in particular the universities and colleges, to undertake the solving of scientific problems. E.E.B.

N66-12404* National Aeronautics and Space Administration, Washington, D. C.

NASA'S PROGRAM IN ADVANCED RESEARCH AND TECHNOLOGY

Raymond L. Bisplinghoff *In its* NASA Univ. Program Rev. Conf. 1965 7 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The program in advanced research and technology is carried out at the Langley, Ames, Lewis, Flight, and Electronics Research Centers. Resources amounting to about 10% of the NASA budget are invested in this program. The technologies of space flight are viewed in three steps: from Earth to Earth orbit; from Earth orbit to Moon; and from Moon to planets. The program is designed to improve the reliability of all three steps and for conceiving and developing the new concepts required for the third step which is discussed in detail. The field of energy conversion, materials problems, and the process of measuring or sensing and then using the data obtained to control the flow of energy are considered. Also, communications and the use of lasers for communications and tracking are mentioned. The first space flight experiments with the use of lasers for communications and tracking were conducted with Explorer XXII satellite which was equipped with corner reflectors designed to reflect a laser beam transmitted from the ground back along its original path. Tracking is accomplished through a computer which alines the laser beam with the predicted satellite position. E.E.B.

N66-12406* Michigan Univ., Ann Arbor.

SPACE TRAINING AND RESEARCH AT THE UNIVERSITY OF MICHIGAN

Ralph A. Sawyer *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 8 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The organization of the University of Michigan and its involvement in graduate training and research, particularly in the space-related fields are outlined. The NASA traineeship program at the University supports nearly 2000 graduate students in areas related to the NASA technical program. The NASA-supported research supervised by the members of the faculty of the Department of Aeronautical and Astronautical Engineering has an annual expenditure rate of about $1.5 million. The total sponsored research program of the University (the program supported by other funds than those received from Federal and industrial sources, endowment and gifts, foundation grants, and other outside support) amounted to $42 million. This research program of $42 million constituted 31% of the University's total operating budget of $136 million, of which $41 million came from the legislative appropriation. The NASA traineeship program is discussed and the advantages of this program are presented. E.E.B.

N66-12407* Massachusetts Inst. of Tech., Cambridge.

RESEARCH PROGRAM OF MIT'S CENTER FOR SPACE RESEARCH

John V. Harrington *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 12 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The research program of the Center is composed of three major segments. The first is a program of general space-related research which covers almost all of the major disciplines pertinent to the national space program. It includes the work of some 50 faculty members and a like number of graduate students and is composed of 40 individual research tasks. The second component of the program is a group of larger tasks, six or more ranging from space electronics to psychobiology. The third component is a growing program of experiments in space with particular emphasis on research in the space sciences, the measurement of the interplanetary plasma, the characteristics of the extended solar corona, gamma-ray and X-ray astronomy, and solar radar astronomy. E.E.B.

N66-12408* Wisconsin Univ., Madison. Inst. of Theoretical Chemistry.

INTERDISCIPLINARY RESEARCH IN THEORETICAL CHEMISTRY

Joseph O. Hirschfelder *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 14 p refs (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The Theoretical Chemistry Institute is discussed and the current research being conducted at the institute is summarized. Quantum chemistry, statistical mechanics and transport phenomena, molecular beams and scattering theory, and the applications of quantum and statistical mechanics to biological problems are the major areas considered. The staff of the Institute has 8 professors, 10 postdoctoral research associates, 26 graduate students, and 4 computing programmers. The staff contains experts in quantum mechanics, statistical mechanics, electromagnetic theory, molecular beams, biochemistry, and numerical analysis. Examples of the work being done at this center are given. E.E.B.

N66-12410* Texas A&M Univ., College Station. Space Technology Div.

SPACE RESEARCH AT TEXAS A&M UNIVERSITY

Harry E. Whitmore *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 4 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The research program at the University under the NASA program is discussed and the new space research complex is mentioned. Heat transfer from plasma jets, the mathematical investigation of the structure of light metals, the structure of long-chain molecules, cosmic ray muons, and the materials science programs are among the areas discussed. A project concerning space structures is underway to investigate impact attenuation devices, shell structures, and aerospace materials. The shell research is basically concerned with the structurally anisotropic, thin elastic shell. In particular, it is concerned with an attempt to find a compliance between the elastic constants of an intrinsically anisotropic shell and the physical parameters of a corresponding structurally anisotropic shell. The materials program addresses itself to the effect surface irregularities have on the properties of ultra-high-strength materials. Under impact attenuation the areas being considered are: tubes, tube buckling, collapsible legs, and honeycomb compression. E.E.B.

N66-12411* California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.

THE MULTIDISCIPLINARY GRANT AS A MECHANISM FOR SUPPORT OF BASIC RESEARCH IN UNIVERSITIES

Willard F. Libby *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 11 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The NASA Sustaining University program, the effectiveness of the multidisciplinary grant, the catalytic role of NASA funds, and the visiting scientists program are discussed. Research on the magnetically shielded test facility, plasma studies, chemical effects of ionizing ultraviolet light, and the 24-inch telescope are summarized. The heart of the test facility is a magentically shielded chamber with a cubical working volume 8 feet on a side. Centered in this working volume is a

triaxial system of Helmholtz coils. The diameters of the coils are about 3 feet. Centered within the coil system is a cylindrical temperature chamber with a working volume 11 inches in diameter and 16 inches high. Mountings for magnetometer probes are centered within the temperature chamber. The chamber is presently being used in testing magnetometers for the Mariner spacecraft, the Orbiting Geophysical Observatory, and the Advanced Technological satellites. E.E.B.

N66-12414* College of William and Mary, Williamsburg, Va.
NASA-SUPPORTED BASIC RESEARCH AT THE COLLEGE OF WILLIAM AND MARY
Robert T. Siegel *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 7 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The activities related to the research program supported by the NASA multidisciplinary grant is discussed. A portion of these funds were made available to the biology department for the study of the physiological effects of biological and psychological stresses on small mammals. Particular attention was placed on the rates of production of adrenalin and noradrenalin in small mammals as a function of environment. Most of the funds were used to support activities within the physics department for the support of visible and infrared spectroscopy and plasma physics. Also research in high energy physics has been supported by NASA. The Space Radiation Effects Laboratory is discussed. This laboratory is operated by the College of William and Mary, the University of Virginia, and Virginia Polytechnic Institute. E.E.B.

N66-12415* Washington Univ., St. Louis, Mo.
MULTIDISCIPLINARY RESEARCH AT WASHINGTON UNIVERSITY
George E. Pake *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 7 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The Arthur Holly Compton Laboratory of Physics is discussed and NASA supported research in space sciences is reviewed. The longest standing NASA grant at Washington University is an astrophysical investigation of the primary cosmic radiation. An energy spectrum in the region from 2 to 10 GeV per nucleon for alpha particles has been obtained as well as considerable information on the variation of geomagnetic cutoff energy with arrival direction in the east–west plane. In addition, under the NASA grant a spark-chamber-emulsion assembly is nearing completion. Two spark chambers will be triggered by a scintillation counter telescope. The Multidisciplinary Research Grant effectively supplements project support of programs relevant to space sciences at the University. It allows new faculty members to quickly establish their research activities, permits established faculty members to initiate research efforts in new directions, and supplements related projects. E.E.B.

N66-12416* National Aeronautics and Space Administration, Washington, D. C.
POLICIES FOR SCIENTIFIC PARTICIPATION IN THE NASA SPACE FLIGHT PROGRAM
John F. Clark *In Its* NASA Univ. Program Rev. Conf. 1965 5 p ref (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The policies developed for the formulation and conduct of the space flight program of the Office of Space Science and Applications are reviewed. The NASA space science flight program is a research program in many fields of basic and environmental sciences. Its objectives are suggested by space scientists themselves. Each individual flight project has its own particular scientific objectives which are the direct result of suggestions by scientists. The need for and the broad specifications for a new space flight project are established by the NASA scientific discipline advisory subcommittees. The criteria which the subcommittees use to evaluate a proposal are enumerated and discussed. Also, the kinds of support available to groups interested in space research are outlined. E.E.B.

N66-12421* Midwest Research Inst., Kansas City, Mo.
THE FIRST NASA REGIONAL TECHNOLOGY UTILIZATION PROGRAM—A 3-YEAR REPORT
Charles Kimball *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 11 p refs (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The development of NASA's Technology Utilization Program is traced, starting with the initial effort to stimulate the education, industrial, and economic potential of six midwestern states through greater participation in space science and technology. Various regional experimental programs are described, and several examples are cited of industrial use of space-generated innovations. The development of NASA's in-house technology utilization effort is also discussed, with details given on the activities of the Scientific and Technical Information Division, the Technology Utilization Division, and the NASA centers. The problems involved in technology transfer are analyzed, and the problem areas are identified as existing within corporate management; within the scientific community; in institutional factors; and within the human mind itself. The point is made that these barriers can be overcome only by a mutually purposeful, continuous effort among research scientists, business leaders, university managements, and government officials at all levels. M.G.J.

N66-12422* Stanford Univ., Calif.
THE UNIVERSITY AND TECHNOLOGY UTILIZATION
Frederick E. Terman *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 9 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

In assessing a university's contribution to technology utilization, the subtle factors involved in translating educational capability into industrial development are discussed. These are identified as (1) faculty people possessing the proper qualities; (2) leadership, particularly on the academic side; and (3) hard and persistent work at the job of developing interaction between the university and industry. The role of individual faculty members as technology stimulators is emphasized, and several case histories are presented to support this contention. The point is made that a university with a good graduate program, good faculty, and research funds is potentially capable of stimulating technology utilization, but that stimulation does not occur automatically; it must work at the job hard and continuously until habits of interaction are well established, and many participants are involved. M.G.J.

N66-12423* Indiana Univ., Bloomington. Aerospace Research Applications Center.
PROGRAMS OF THE INDIANA UNIVERSITY AEROSPACE RESEARCH APPLICATIONS CENTER
Arthur M. Weimer *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 8 p refs (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The role of the Aerospace Research Applications Center in transferring various research and development efforts to private business firms is described. The program involves the

dissemination of information available from NASA's Scientific and Technical Information Facility; using the scientific and management faculty personnel of the university for panel discussions with cooperating member firms; and providing managerial services of special types. Some examples of technical assistance to member companies, which resulted in improved methods, are cited. Experiments in the areas of technical marketing services, innovation, and entrepreneurship are also discussed. The point is made that these programs have had an influence on the campus as well as on the relationships of the university to industry and to government. M.G.J.

N66-12424* Wayne State Univ., Detroit, Mich.
WORKING AT THE INTERFACE
Randall M. Whaley *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 17 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

Details are given on the establishment, organization, and operation of the Center for the Application of Sciences and Technology (CAST) at Wayne State; its main objectives are the effective transfer of the results of aerospace-related science and technology to local industry. The experiment has confirmed that direct transfer of a product or process in its entirety rarely occurs; modification for improvement of a marketable existing product is the most probable type of utilization; and, under certain circumstances, interpretation and transmission of information is of significant value in corporate planning and in reaching decisions on research efforts. Several examples are given to illustrate these general types of utilization. Incidents are also cited as indications of a beneficial feedback into the academic life of the institution as a result of the program. M.G.J.

N66-12425* Maryland Univ., College Park.
SOME ASPECTS OF THE INDUSTRIAL APPLICATIONS PROGRAM OF THE UNIVERSITY OF MARYLAND
Philip Wright *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 6 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

In a study of conditions underlying the transfer of technical knowledge to industry, emphasis is being placed on identifying the factors which may impede or facilitate this transfer. The possibility of designing a program to advanced the Industrial Applications Program of the NASA Goddard Space Flight Center, and to augment its capacity to promote industrial progress in Maryland is also being considered. Efforts to transfer new technology into the commercial sector were examined, and results show that up to 90 percent of available new technology is unlikely to find immediate commercial application. The gap between the technical feasibility of any new proposal and the areas of marketability and profitability is also discussed. Some practical aspects which the program hopes to accomplish include: (1) catalyzing and facilitating the commercial use of NASA technology, and sustaining nonnegative situations to the point of commercial utilization; (2) indicating areas of technology with a high utilization prognosis, and identifying industries and companies in which the utilization prognosis is more pronounced than in others. M.G.J.

N66-12426* Rensselaer Polytechnic Inst., Troy, N. Y.
EDUCATIONAL AND INDUSTRIAL IMPACT OF THE NASA MATERIALS RESEARCH CENTER AT RENSSELAER
Richard G. Folsom *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 8 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

Details are given on the funding, design, and construction of the Materials Research Center. According to the memorandum of agreement with NASA, the Center was built to create a broadly based, multidisciplinary team for exploring mechanisms whereby progress within materials research in particular, and space science and technology in general, may be fed into industries and segments of the economy with which Rensselaer has close relations. The interdisciplinary approach used at the Center is discussed, and the resultant benefits to graduate students and to the Institute in attracting faculty members with high capabilities are stressed. M.G.J.

N66-12427* Pittsburgh Univ., Pa.
SPACE PROGRAMS AND THE TOTAL UNIVERSITY
Edward H. Litchfied *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 6 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The basic role of universities in contemporary life is examined in relation to the commitments implied in NASA's memorandum of understanding. The traditional values and past preoccupation with strictly academic matters, inherent in the university concept, are assessed, and the factors which make it necessary to develop broader concepts are discussed. The need to fully and frankly acknowledge the role of serving as a comprehensive vehicle for social action, to acknowledge problems, and to organize in an attempt to solve them is given as a basic premise for recognizing the NASA commitments. The creation of the Space Research Coordination Center, as a way of integrating a total institution, and the strengthening of the space-related disciplines are briefly described, as examples of fulfilling these commitments. M.G.J.

N66-12428* Chicago Univ., Ill.
UNIVERSITY RESEARCH IN SPACE AND THE ROLE OF FACILITIES GRANTS
J. A. Simpson *In* NASA, Washington NASA Univ. Program Rev. Conf. 1965 7 p (See N66-12401 03-34) GPO: HC $1.50; CFSTI: MF $2.00

The need for innovation within universities to meet the challenge of changing conditions in scientific research financed by Federal funds is discussed. It is pointed out that in space experiments the administrative and technical interfaces constitute several parallel communication links between the university investigator and NASA staffs, and that space science is interdisciplinary in character. These factors require administrative and technical innovation by the university, and its senior scientific staff and students, to retain both their responsibility for the experiment, and the drive for scientific excellence within the laboratory. Approaches to these problems are outlined, in which individual faculty members are supported by small professional staffs who assist in preparing space experiments and, at the interface, maintain communication channels with NASA. The recommendation is also made that universities should not be treated as industrial facilities. Several points are offered regarding the conduct of space experimentation, including the problem of meeting the time schedules of planets, and the participation of small universities in the programs. M.G.J.

N66-12471# Congress. Senate. Committee on Aeronautical and Space Sciences.
ALTERNATIVE GOALS FOR THE NATIONAL SPACE PROGRAM FOLLOWING THE MANNED LUNAR LANDING
Washington, GPO, 1965 385 p Hearings before Comm. on Aeron. and Space Sci., 89th Congr., 1st Sess., 23–25 Aug. 1965 GPO: $1.00

Collections of NASA Documents

Hearings before the Committee on Aeronautical and Space Sciences of the United States Senate are presented on alternate goals for the national space program following the manned lunar landing. Discussions were held on alternative goals for the near future, to 1975, and the more distant future, 1985 and beyond; the comparative merits of manned and unmanned missions to achieve these goals; the money, time, and technology needed; the definition and role of Apollo extension systems and the Manned Orbiting Laboratory in the space program; and unmanned and manned flights to Mars. R.N.A.

N66-12516# Office of Aerospace Research, Washington, D. C.
AIR FORCE RESEARCH RESUMES, 1964, VOLUME 5
Jun. 1965 554 p refs
(OAR-65-4, Vol. 5; AD-621879)

Contents: General physics; nuclear physics; chemistry; mathematical sciences; electronics; materials; mechanics; energy conversion; terrestrial sciences; atmospheric sciences; astronomy and astrophysics; biological and medical sciences; behavioral and social sciences; OAR exploratory development. TAB

N66-12568# Naval Personnel Research Activity, San Diego, Calif.
A METHOD FOR STRUCTURING TECHNICAL TASKS
Joe Silverman Aug. 1965 43 p refs
(STB-66-4; AD-620839)

Research is being conducted to develop a method for determining technical skills required for current and future weapons and support systems which will serve as a basis for the Navy enlisted classification structure required in the next decade. This report describes a statistical technique which has been devised to classify work tasks by their level of complexity. Copies of the questionnaires, task lists, and other forms associated with the task classification method are contained in a Technical Supplement. Author (TAB)

N66-12644# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME NO. 11
Nov. 1965 68 p refs Sponsored by Dept. of Defense

CONTENTS:

1. ANALYSIS OF ATMOSPHERICS PROPAGATED OVER LAND AND SEA MASSES S. G. Hibben p 1–11 refs (See N66-12645 03-13)
2. ELECTRON-BEAM-PUMPED CdTe AND GaSe LASERS C. Shiskevish p 12–17 refs (See N66-12646 03-16)
3. ORIGIN OF THE EARTH'S RADIATION BELTS AND THE CORRELATION BETWEEN THE BELTS AND THE IONOSPHERE E. Gelins p 18–28 refs (See N66-12647 03-29)
4. A NEW METHOD FOR SOLVING LAMINAR BOUNDARY-LAYER PROBLEMS V. Klein p 29–32 refs (See N66-12648 03-12)
5. THE SEARCH FOR HIGH-TEMPERATURE SEMICONDUCTOR MATERIAL (USSR) J. G. Kourilo p 33–37 refs (See N66-12649 03-26)
6. HIGHLIGHTS OF SOVIET BIOASTRONAUTICS AT THE 16TH IAF CONGRESS B. N. Mandrovsky p 38–48 refs (See N66-12650 03-05)

N66-12751# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 244
23 Nov. 1965 54 p refs Transl. into ENGLISH from Chinese periodicals
(JPRS-32985; TT-65-33562) CFSTI: $3.00

CONTENTS:

1. THE DEVELOPMENT OF CYBERNETICS S.-h. Hu p 1–16 refs (See N66-12752 03-05)
2. THE FIRST NATIONAL MEETING OF ENGINEERING THERMAL PHYSICS C.-h. Wu p 17–24 (See N66-12753 03-33)
3. THE FORMATION OF THE SECOND MAXIMUM IN THE CLOUD GRAPH L. Hai p 25–31 refs (See N66-12754 03-20)
4. STUDIES ON ORGANOPHOSPHORUS COMPOUNDS. III: DIALKYL N,N-DISUBSTITUTED AMINOMETHYL PHOSPHONATE AND THEIR DERIVATIVES H.-c. Chiang p 32–44 refs (See N66-12755 03-06)
5. COMPARISON OF THE RADIATION SENSITIVITY OF CHROMOSOME IN WHITE BLOOD CELLS OF HUMAN BEINGS, MONKEYS, AND RABBITS H.-t. Chou p 45–50 refs (See N66-12756 03-04)

N66-12812# California Univ., Berkeley. Operations Research Center.
STATISTICAL EXPERIMENTS WITH A TWO-LANE FLOW MODEL
Robert M. Oliver and Tenny Lam Jul. 1965 22 p refs
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-65-20; AD-622500)

In this paper, the authors describe a series of experiments which have been used to evaluate a theoretical model of lane changing and passing maneuvers. The experiments were performed on two unidirectional lanes of a four-lane freeway. In the introductory sections there is a theoretical discussion of the lane-changing model. The third section of the paper describes the experiments and the measurements which were made. A fourth and fifth section report on the analysis of experimental data. Data obtained for the mean and variance of lane changing flow rates are compared with theoretical values computed from variance and covariance functions of lane flow rates and lane velocities. Author (TAB)

N66-12825# Stanford Univ., Calif. Dept. of Statistics.
RANDOM PACKING DENSITY
Herbert Solomon [1965] 34 p refs
(Contract Nonr-225(52))
(TR-105; AD-619420)

Random packing of spheres in two-dimensional, three-dimensional and higher spaces is investigated. In one dimension this reduces to the 'parking problem' which has been studied by several authors. Some restricted random packing is analyzed in one, two, and three dimensions. The latter case is of interest in physical chemistry in connection with 'loose' and 'dense' random packing. Extensions of these concepts to lower dimensions yields some theoretical values of interest in a one-dimensional modified parking problem. Some applications of random packing are discussed. Author (TAB)

N66-12890# Naval Weapons Evaluation Facility, Albuquerque, N. Mex.
THE CIRCULAR RUNWAY
Jun. 1965 39 p
(AD-622152)

This report has been compiled to inform interested persons of the current status and thinking associated with the circular

aircraft runway concept. It is a new concept and an exciting one to contemplate. Perhaps it will never come into being, but regardless, the authors hope that this pamphlet will stimulate further thought on the subject, both pro and con. Admittedly the report has been written with a positive approach to the subject. Essentially, we feel the idea has definite merit and deserves further investigation by any person or organization which might profit by its application. TAB

N66-12893# Chicago Univ., Ill.
[RESEARCH IN THE MATERIALS SCIENCES] Fourth Annual Technical Report, Jul. 1, 1964–Jun. 30, 1965
15 Oct. 1965 73 p refs
(Contract ARPA SD-89)
(AD-473078)

The program of research in the materials sciences area at the University of Chicago of the Advanced Research Projects Agency is presented. The research is performed within the following administrative units of the Division of the Physical Sciences; the Department of Chemistry, the Department of the Geophysical Sciences, the Department of Physics, the Institute for the Study of Metals and the Enrico Fermi Institute for Nuclear Studies. The work performed during the year is summarized. All research in the field of materials sciences is described since ARPA support has been of direct or indirect benefit to all of these activities. However in the case of each investigator (1) the particular part of the work supported by ARPA has been stated, (2) the participating graduate students who have received their financial support from ARPA have been named, and (3) any pieces of capital equipment or general facilities provided by ARPA funds have been described. The Appendix lists all of the faculty members in the program on 1965 July 1. Author (TAB)

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Texas: Fort Worth, San Antonio
Washington: Seattle
Wisconsin: Milwaukee

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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